173/2019

WORLD OF PORR

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KARL-HEINZ STRAUSS, CEO

Karl-Heinz Strauss, CEO. Source: PORR AG

Dear ladies and gentlemen, dear business partners,

We have given our World of PORR a complete overhaul. Not only does our specialist magazine now feature a new layout, but by visiting worldofporr.com you can embark on a digital journey into our world. Take a peek behind our site fences, discover our diverse array of projects and explore a wealth of background information. Make sure you pay regular visits to our World of PORR, as our experts will be reporting on our current construction schemes to keep you up to date.

In this print edition of World of PORR, our journey takes us from the Loftesnes Bridge in Norway across to Munich, where we've applied BIM and LEAN design to erect an office building for BMW. Then, over the Golbach Valley Bridge, we continue into Switzerland and the canton of Graubünden, where we've connected people by applying intelligent building to construct the Albula Tunnel II between Preda and Spinas. Near the Austrian border, we've created the largest run-of-river hydroelectric plant in the Alpine region.

Our projects in Austria include the successful implementation of the Pirka recycling facility – which will process and sort some 180,000 tonnes of construction waste. Continuing through the Koralm Tunnel in Carinthia and past the forestry training centre in Traunkirchen brings us to Vienna. Our projects here have included a general renovation of Pavilion 1 at Hietzing Hospital and a new residential building on the Rosenhügel.

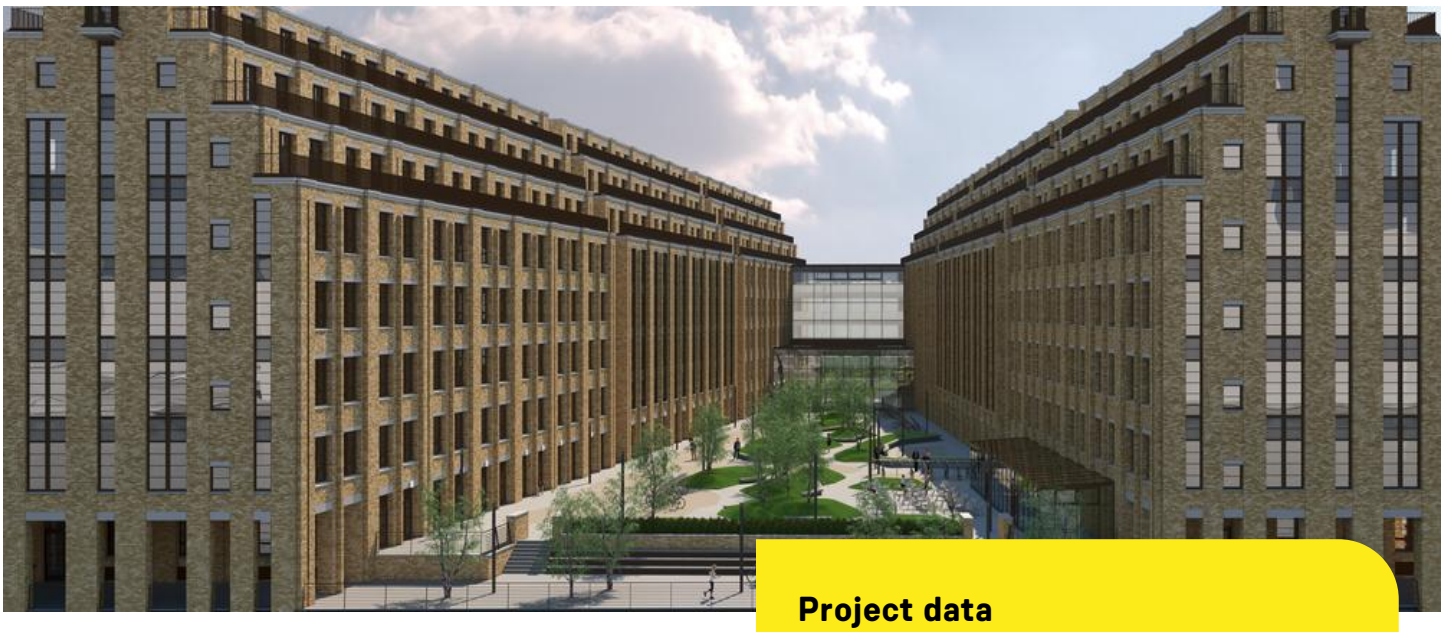
The year 2019 is a special one for PORR as we celebrate a major milestone. For 150 years, we've been accumulating knowledge and experience. For 150 years, we've been turning intriguing projects into reality. For 150 years, we've been creating custom solutions to overcome every challenge. As one of leading providers in Europe, we connect people, pursue intelligent growth and are ideally positioned for the future. Our operating result for the first nine months of 2018 is testament to this.

By recording positive results in Q3, PORR has continued a positive trend from the start of the year. As expected, production output rose by 21.3% to EUR4,055 million in the first nine months of 2018. This means that, in a challenging market environment, PORR generated earnings before taxes (EBT) of EUR31.2 million, an increase of 9.9%. At EUR6,837 million – an increase of 17.7% – our order backlog remains at record levels. The most significant order received in the third quarter in Austria was the Brenner Base Tunnel, the largest tunnel construction contract in the history of Austria. This is just one of many exciting projects that the approximately 20,000 PORRians in our markets are implementing.

I hope you enjoy reading this issue and your journey into our new world - whether in this print edition or online at worldofporr.com.

Best regards,

Karl-Heinz Strauss



IN PROGRESS
GERMANY/BERLIN/2018-20

OFFICES WITH VISION

Neue Spreespeicher project in Berlin

Author: Susan Glöckner

An office complex on the Spree, comprising six building elements and a multi-story glass hall, is currently under construction

PORR is completing the premium building shell construction and finishes on four of the buildings. Although the design is reminiscent of the old warehouse building, the very latest technology is being used throughout the planning, construction and operation of the buildings - 3D modelling, model presentations and the use of 3D data to control the technical building services works.

Project data

Employer	Cuvrystrasse 50-51 Berlin GmbH
Contractor	PORR Deutschland GmbH
Architect	PORR Design & Engineering GmbH
Order type	Main contractor
Project type	Building construction . Residential building . Design & Engineering
Project scope	Design and construction of an office complex in Kreuzberg, Berlin
Order volume	46 million euros
Construction start	01/2018
Construction end	01/2020

Background

The "Neue Spreespeicher" project on the former German-German border is located on a site rich in history - but the project itself can look back on a lengthy history as well. Planning permission was obtained back in 2002 for the construction of offices and a hotel in the Schlesische Strasse area. In the typical Kreuzberg fashion, the empty site was promptly transformed into a tent city, occupied by squatters for several years, and causing execution of the project to be postponed for the first time. After a lengthy process of negotiations, the occupants were finally persuaded to vacate the premises in 2017. In the meantime, however, the client's main focus had shifted and the building permit for the hotel was converted to office space.

In the spirit of community-building, a neighbourhood shop measuring approx. 200m² has been included in the plans as a social gathering place for the district. Moreover, the public outside spaces will be open to all of Berlin's residents. The green, tree-filled inner courtyard is connected to the street by public passageways, while a planned path along the Spree will provide all Kreuzbergers with the opportunity to enjoy the river views from well-placed park benches and steps.

View across the Spree to the new construction. Source: PORR

Success with BIM and LEAN

Once the site was again available for construction, the project made rapid progress. In July 2017, PORR secured the contract for main contracting services to a value of more than 46 million euros for a premium shell construction and finish on four buildings, including outside areas. In collaboration with PORR Design & Engineering GmbH (PDE) as general planner, the project was soon drafted. Due to the application of Building Information Modeling (BIM), now the standard method used at PDE, the necessary interfaces and action points were soon established and resolved. LEAN design methods, used in the planning development and involving construction management as well, enabled the efficient exchange of data between planning and execution

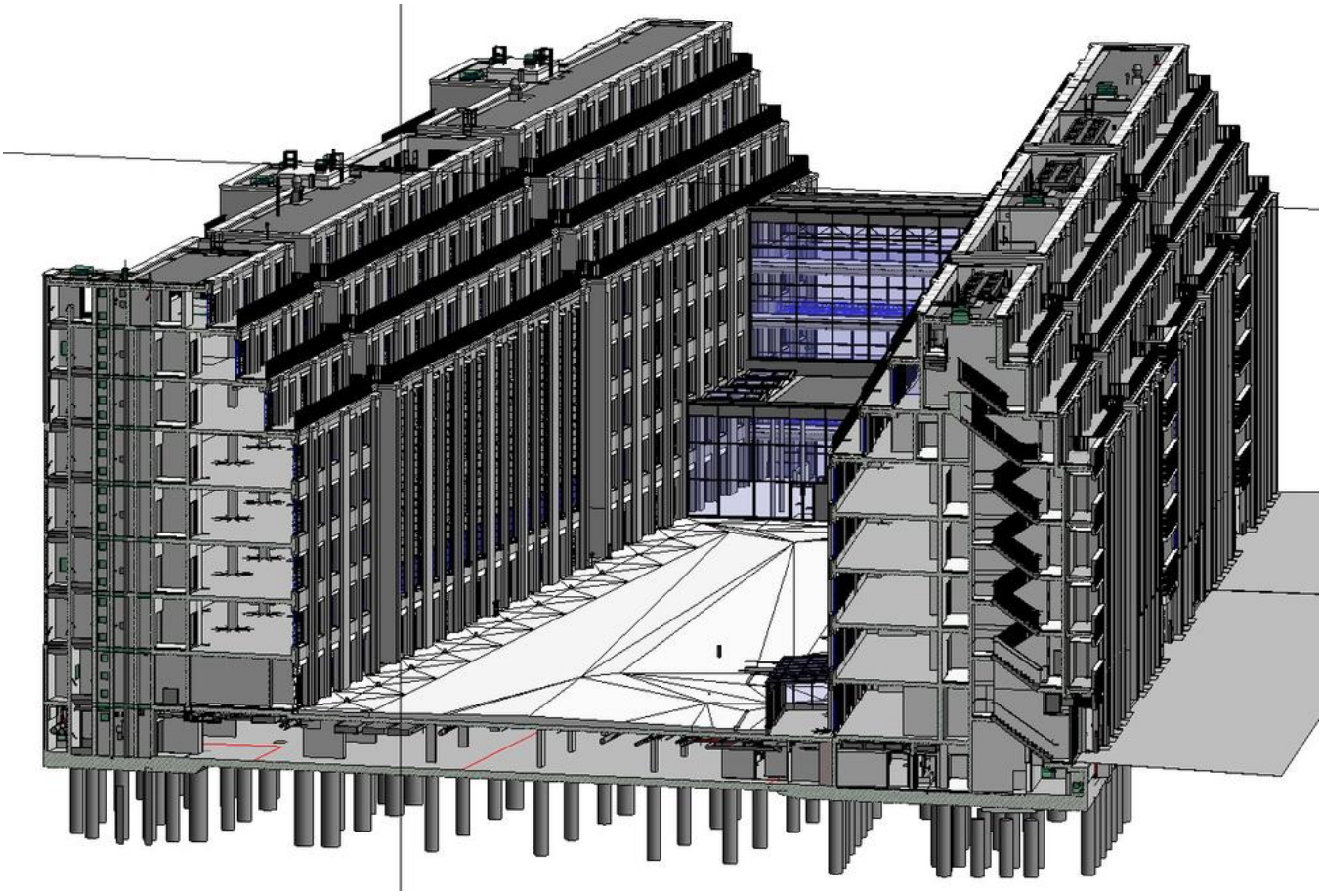
THANKS TO BIM AND LEAN METHODS, THE EXCHANGE OF INFORMATION BETWEEN PLANNING AND EXECUTION WAS VERY EFFICIENT.

Susan Glöckner, Project manager
PDE Deutschland

Technical data

approx. 400.000m³
Water pumped out

Gross surface area	39.192m²
Plot area	9.805m²
Floors	8 upper floors, 1 underground floor



3D-modelling of all elements in the course of the execution planning facilitated cooperation and improved the transparency of processes.
Source: PORR

Cooperation across all levels

Cooperation and the exchange of information were not only emphasised within the PORR team, but PORR was also able to bring years of experience to bear in discussions with future tenants. The combination of service provision facilities and dining areas in the ground floor and high-quality office spaces in the upper floors demanded a variety of specifications from the building equipment. These had to be taken into consideration during planning and execution, and the future rental properties outfitted accordingly. This meant that adequate commissioning of the building equipment shafts and the need for assembly areas on the ground floor, with the requisite larger sprinkler control centre, were successfully dealt with in the execution planning stage.

ALL GENERAL PLANNING PROJECTS BY PDE WERE MEANWHILE IMPLEMENTED WITH LEAN DESIGN AND BIM METHODS.

Markus Strobl, Managing director
PDE Deutschland

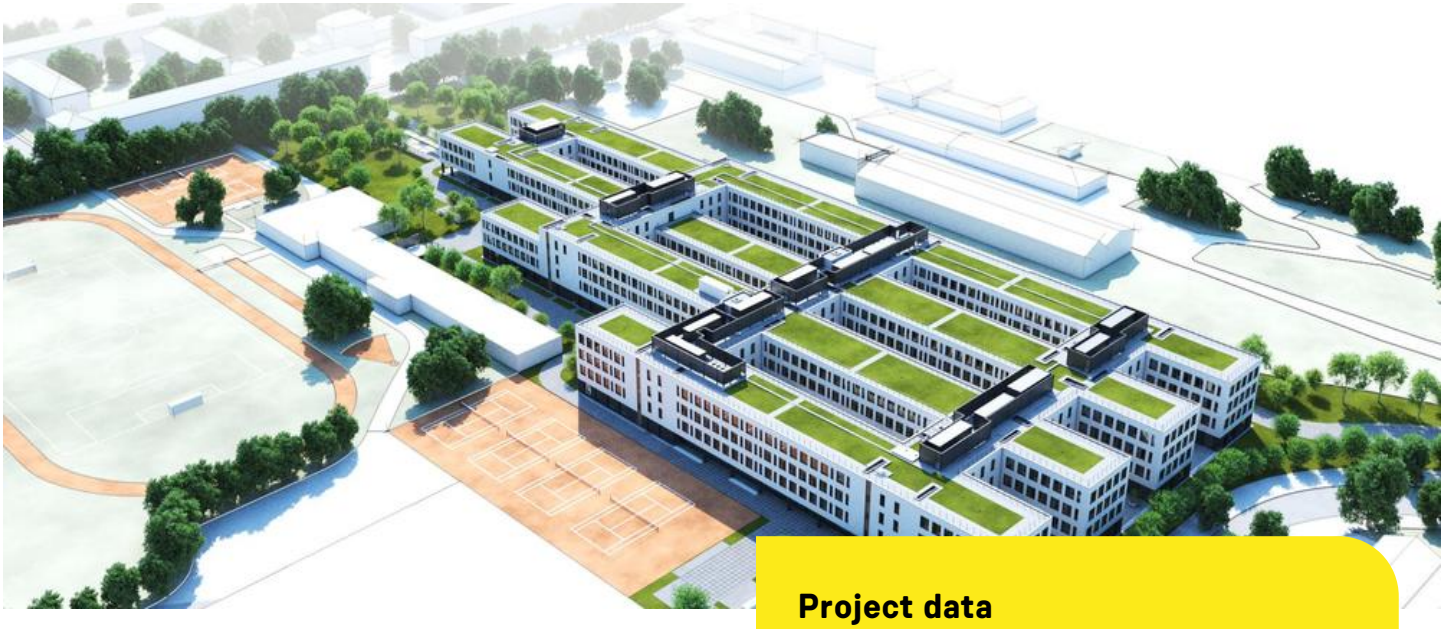
Working on and under the water

Work on the construction site itself began with the handing over of the site facilities at the beginning of 2018. The site's location right beside the Spree necessitated extensive dewatering of the construction pit. This amounted to around 400,000m³ of water pumped out and returned to the Spree. After this, the construction pit had to be filled with the basement floor as quickly as possible, to minimise the dewatering period. In addition, a professional diver was hard at work in a dry suit, flame-cutting the sheet-pile wall, installing protective grating for the inflow structure and manufacturing the facade connections under water.

A growing shell

Above the water, meanwhile, structural works were well underway. At present, two buildings have already been constructed and the building services finishes are beginning in the shafts. The external appearance of the project is just as important as the interior construction. The patterned facade was examined by the critical eyes of all project participants and formed the first impression of the building's imposing image, which will later on become widely visible as the Neue Spreespeicher.

Approx. 400,000m³ of water had to be pumped out of the construction site. Source: PORR



PROGRESS: 100% - COMPLETED
GERMANY/MÜNCHEN/2016-18

STATE-OF-THE-ART PLANNING WITH BIM AND LEAN

The OST BMW Freimann office building in Munich

Author: Roman Galler

For the BMW Freimann project, PORR Design & Engineering prepared the design, tender and execution planning. Cost and time constraints were tight.

The scope of services included planning and consulting services for a four-storey office building with an underground car park and a conference and catering area. PORR relied on integral planning, building information modeling (BIM) and LEAN design

Project data

Employer	BMW AG
Contractor	PORR Design & Engineering GmbH
Order type	General planning
Project type	Design & Engineering, Building Construction
Project scope	General planning of design, tender and execution
Construction start	10/2016
Construction end	02/2019

Background

The new OST office building in Freimann will serve to combine in one building the various sectors of the BMW bank, BMW sales and all the departments of the leasing provider Alphabet International, which have previously been distributed across numerous sites. The construction boasts a gross floor area of around 72,500m², containing 2,229 flexible work spaces for 3,120 staff.

The design, tender and execution planning elements were carried out from October 2016 through the efforts of PORR Design & Engineering GmbH (PDE) with the support of the specialist fire protection department and PDE Design Studio.

This project was realised from June 2017 in a joint venture with the PORR Bau GmbH . Major Projects department and PORR Deutschland GmbH. PORR operated during the planning and execution phases using building information modeling (BIM), LEAN management and integral planning methods to form a holistic project approach incorporating all key trades.

The new office complex occupies a built area of approx. 19,700m². Source: PORR

Tight time and cost constraints

From the very beginning of the implementation of this project, PORR was presented with very clear concepts and specifications from the employer. The architect's original design exceeded the budget by some 10 million euros. As a result, after the second work phase, PORR Design & Engineering received the contract to use value engineering to identify optimisation potentials, so as to be able to meet the requirements of the costing framework. The successful completion of this challenging assignment secured not only the general planning contract, but also subsequently the contract for the construction of the office building for PORR. In the role of general planner, PDE then had to adhere strictly to the time and budget limitations from work phase 3. For the best possible operating result within the specified cost framework, PORR chose a design-to-budget approach for the design planning. This required all work elements of the overall project to implement project goals within the cost framework specified by BMW.

The tight time constraints necessitated the reversal of the design and building application processes. The building application was submitted initially on the basis of the preliminary draft. The design process took place alongside this application process and, in large part, after it. This meant that incorporated changes from the design phase had to be approved via a modified planning application.

An additional specification by the client was that the construction scheme was, so far as possible, to be implemented as a modular construction with the use of prefabricated system elements. This included the use of prefabricated concrete sections for ceilings, walls, façade elements and stairways, as well as complete shafts with prefabricated building services installations, among others.

From project participant to project partner

In the course of the BMW Freimann project, PORR realised what has been, with many other construction projects, nothing more than a nice idea: the new BMW complex is a genuine joint project. The client worked closely together with PORR and its partner subcontractors in a partnership model, from the planning right through to the turnkey completion of the project. In addition, they brought their specific knowledge, experience and know-how to bear. Contrary to widespread fears, this partnership model did not displace any of the project participants, but instead significantly improved collaboration. In this way, the participants became true project partners.

A REAL JOINT PROJECT, IN WHICH CLIENT AND ALL PROJECT PARTICIPANTS WORKED CLOSELY TOGETHER FROM THE VERY BEGINNING.

Roman Galler
GP4 Team Leader, PORR Design&Engineering

Integral planning

An important aspect of a joint construction project is the integral planning, the simultaneous participation of all the relevant technical disciplines in the planning process. An important element of this is the early inclusion of all important experts in the planning team and their simultaneous and concerted effort in completing planning tasks. On the basis of this concept, project planning for the Freimann project was carried out together with all participating professional groups. Close teamwork among

PDE, PORR Major Projects, PORR Deutschland Munich branch and the companies responsible for executing the most important works (such as building services planning, façade, interior fittings and building automation) was a crucial factor in this process. The people responsible for the project in all these specialist areas were involved in the planning process from the very beginning. They participated actively in the planning process, regular planning conferences and the creation of planning-relevant documents and papers. The know-how of the executing works was integrated into the design planning process and, further along, in the execution planning as well.

BIM and LEAN

In order to streamline and optimise the planning process from the very beginning, and to implement the required cost savings, PDE made use of LEAN design methods. This meant the various teams worked in a collaborative production plan on concrete preview and work packages. These plans were evaluated together every week in a so-called “PEP” talk (production-evaluation-planning), and new work packages were determined for the next week. In this way obstacles, deviations and idle periods could be identified early and eliminated.

Further along the process, this collaborative planning resulted in a digital building model with the application of BIM. All relevant construction data were digitally modelled, combined and measured and geometrically visualised as a virtual model with BIM. This three-dimensional building model included the architectural works as well as the structural framework planning. Owing to the abundance of data in the area of mechanical & electrical engineering, a separate model was established, which was then integrated into the main model. The use of BIM was a fundamental requirement of the client, with a view to to controlling the later operation of the building with the digital building model and linking with the requirements of the BMW facility management system.

Active exchanges of ideas are expected in the many project areas. Source: PORR Design & Engineering

Impressive result

The new building complex extends across a length of more than 248m and a width of 96m, and is divided in a comb-shape with four wings and connecting structures. The building structure required regular atriums, which provide plenty of daylight to the office areas.

The offices are designed as open-plan flexi-offices and include so-called think tanks for uninterrupted conversations, conferences and group work. The ground floor area contains additional usage spaces for the dining facilities, cafeteria, conferences and presentations (closed room) as well as a BMW Group fitness centre.

The internal areas of the connecting wings house communication zones with kitchenettes. Source: PORR Design & Engineering

The exterior of the building is designed as a perforated façade with light façade plaster, which forms a marked contrast to the darker face of the ground floor.

The building uses state-of-the-art building services technology and provides the office, meeting and conference areas with regulated mechanical ventilation combined with a heating-cooling ceiling. The single-storey underground car park covers the full area of the building complex.

The grounds will provide a pleasant recreation area with plenty of trees and greenery in the open air. The underground car park will contain spaces for around 450 passenger vehicles and 85 bicycles. Additional parking places for cars and bicycles will be located outside the building.

The area outside the main entrance, as well as the foyer, is intended to contain vehicle display areas. Source: PORR Design & Engineering

Sustainable construction

The building is subject to BMW's own evaluation system for sustainable construction, which is similar to the requirements of the international LEED label and the German DGNB standard. PDE paid particular attention to material selection, water and energy supplies from the very beginning of the project, with a view to environmentally friendly planning. PORR's own “Sustainable Construction” reference system determined the integration of sustainability aspects such as user comfort, material ecology and local supply.

Result

Through the partnership model and the integral planning approach, the works carried out were incorporated into the planning right from the beginning of the project. This means that the requirements specified by the client were able to be implemented within the required cost and time limitations. Through the application of LEAN principles in the project development, PDE ensured that the construction work was ready to begin in June 2017, as desired by the client.

Technical data

72.500m²
Gross surface area

35.700m²
Plot area

19.700m²
Built-up area

Car parking spaces	665
Bicycle parking spaces	412
Total number of staff	3.120
Flexible workspaces	2.230
Desk sharing factor	1:1,4

GENERAL RENOVATION OF A HISTORICAL HEALTH FACILITY

Barely recognisable: PORR has given Hietzing Hospital's Pavilion 1 a gleaming new lease of life. Source: Fotostudio Semrad

PROGRESS: 100% - COMPLETED
AUSTRIA/WIEN/2016-18

Pavilion 1 of Vienna's Hietzing Hospital

Author: Peter Kinka, Herbert Gruber

PORR carried out an extensive general renovation of the Hietzing Hospital, Pavilion 1, in compliance with strict regulations for the heritage-listed building.

The fabric of the historical building made the project, above all, a structural challenge. The PORR specialists made use of various building techniques to come up with a solution for every special case and surprise that the project presented them with.

Project data

Employer	City of Vienna - Wiener Krankenanstaltenverbund (Vienna Association of Hospitals)
Contractor	Hietzing Hospital consortium: PORR Bau GmbH, DI Wilhelm Sedlak GmbH
Architect	Pavillon 1 ILF-be consortium: ILF Consulting Engineers Austria GmbH, Baumschlager Eberle Wien AG
Order type	General contractor
Project type	Building construction, Health care facilities
Project scope	General renovation of a heritage-listed hospital building
Order volume	25 million euros
Construction start	11/2016
Construction end	05/2018

Overview

In 1907, the year of Kaiser Franz Joseph I's silver jubilee, the City of Vienna made the decision to build the first hospital of its own, rather than continue to entrust all the medical care of its population to the various charitable and religious hospitals. The new hospital, named the Kaiser-Jubiläums-Spital, was built between 1908 and 1913. A pioneering project that included ten hectares of parkland and pavilions laid out based on specialist areas, the hospital was classed as an international flagship. After the First World War, the facility was renamed simply to "Lainz Hospital". Today, the health facility is known as Hietzing Hospital with the Rosenhügel Neurological Centre.

Project background

Pavilion 1 is home to the psychiatric department, and its exposed location makes it a very visible "shop window" for the hospital. However, the building was not only showing signs of age, it was also bursting at the seams. The Vienna Association of Hospitals therefore decided it was time for comprehensive modernisation and extension. Before the general renovation could begin, a multi-stage tendering process took place. A consortium comprising PORR Bau GmbH and DI Wilhelm Sedlak GmbH was awarded the general contractor Package 1, worth around 22 million euros and comprising both building work and mechanical & electrical engineering. The consortium offered the best price-performance ratio, but the numerous references from the fields of both health and heritage-listed properties were also crucial to the decision. The consortium partner was responsible for the commercial development, while PORR acted as the overall lead and took on the technical management. Site supervisors and foreman came from PORR's Major Projects Building Construction department, and the experts in renovation and construction under heritage preservation requirements came from the PORR Revitalisation department. These main contractor services were rounded off in the second stage with the award of main contractor Package 2, worth around 3 million euros. Other PORR subsidiaries handled finalisation of the building with sewage systems and external facilities.

A view from the crane cab shows the vast scope of the structurally challenging demolition work. Source: PORR

DURING THE DEMOLITION WORK IT WAS QUITE A FLUKE IF NO SURPRISES POPPED UP.

Peter Kinka
Group Leader, PORR Bau GmbH

Demolition and gutting

Immediately the site facilities were in place, work began on demolishing and gutting the building. Admittedly, there were a few nasty surprises, such as missing supports for a log ceiling, or the paper-thin concrete cover on an old floor restoration, but the specialists from PORR Revitalisation were able to rise to every challenge.

Before it was possible to begin the extensive demolition work, structural strengthening measures had to be carried out for the load-bearing components, so that additional shafts for building services, lift shafts and staircases could be built. In addition, the below-ground level had to be secured and dried out. In order to create valuable space in the basement, the metre-thick brick walls were treated with suitable injections.

The metre-thick brick walls in the lower floor were dried out using injections. Source: PORR

Extensions

The new spatial concept in Pavilion 1 enlarged the building with an underground garage and two extensions for offices. The particular challenge here was to secure the fragile existing building with suitable underpinnings. During demolition of the external hull, the ceilings had to be shored up several times with stiffening grilles and heavy-duty scaffolding.

The facade is a mixture of exposed brickwork and plastered surfaces. The federal heritage authority participated in the careful restoration process, which has preserved it in good condition for future decades. Despite the high-quality modern facade, the new extensions fit harmoniously into the overall architectural appearance.

In order to create space for the large building services equipment, the top floor was extended using steel structures. The roofing work was completed successfully following the topping-out ceremony in September 2017.

The ceilings had to be shored up and secured with underpinnings several times during the demolition work. Source: PORR

WE EVEN MANAGED TO FULFIL ADDITIONAL CLIENT REQUIREMENTS WITHOUT GOING OVER BUDGET.

Herbert Gruber
Site Supervisor, PORR Bau GmbH

State-of-the-art technology

PORR also ensured that the hospital is running on fully modern technical infrastructure. The work done to bring hospital operations right up to date included special safety equipment for fire protection, safety monitoring, monitoring of persons, and safe evacuation of the building. As part of the contract, experts from the Hietzing Hospital were involved in agreeing all preparation work and coordination for the installation of the medical equipment; this ensured that installation and commissioning of the equipment could follow on seamlessly from the construction work.

The ingenious architecture lets natural light into the original spaces despite the additions. Source: Fotostudio Semrad

Technical data

14.900m²
Gross surface area

6.000m²
Plot area

Construction pit depth	6m
Number of storeys	6
Patient rooms	77
Beds	140
Stations	7
Outpatient clinics	1

Summary

Commissioning, trial runs, acceptance, training, and the final handover to the operator are particularly demanding for health facilities and it is essential to meet the most demanding quality criteria. PORR accomplished all these tasks to the fullest satisfaction of the client, and Pavilion 1 was handed over on schedule in May 2018, ready for operation. PORR not only stayed within budget, we were in fact able to introduce numerous ideas or suggestions that allowed various special requests to be met without incurring additional costs.

Internal views of the new Pavilion 1. Source: Fotostudio Semrad

PROGRESS: 100% - COMPLETED
SWITZERLAND/WINDISCH/2016-18

A FINE PLACE TO LIVE

FEINSPINNEREI freehold flats in the Swiss municipality of Windisch

Author: Andreas Bart

In just 22 months, PORR has constructed the Feinspinnerei residential building on former industrial wasteland in Windisch.

PORR relied on unconventional solutions for the implementation in order to master the logistical and constructional challenges: from the site facilities being located in a residential area to the tight dimensional tolerances between subsections.

Project data

Employer	HIAG Immobilien Schweiz AG
Contractor	PORR SUISSE AG
Order type	Total contractor
Project type	Building construction residential building
Project scope	Construction of a five-storey residential building with 29 freehold flats
Order volume	12 million Swiss francs (10.5 million euros)
Construction start	08/2016
Construction end	05/2018

General

The client, HIAG Immobilien Schweiz AG, specialises in the reutilisation of brownfield sites. This includes the former fine-spinning mill in Windisch's Kunzareal, which was one of the largest spinning mills in Switzerland in the 19th century. Numerous listed buildings still bear witness to this eventful past and exude a historical industrial atmosphere. Now an area for residential and commercial use was to be created on the site of the old spinning mill, meeting all modern requirements while preserving the historical heritage. To achieve this, existing buildings were converted, and additional new buildings constructed. Situated right next to protected alluvial forests and the River Reuss, it offers residents a retreat in Switzerland's picturesque Wasserschloss region.

Historic buildings and modern extensions blend harmoniously around the Windisch fine-spinning mill. Source: PORR

Call for tenders

The original architectural competition provided solely for the conversion of the old spinning mill building. In a second competition, it was decided to add a new building with a contemporary appearance, as an optical counterpoint to the industrial character of the existing buildings.

A group of planners developed the project further and prepared a call for tenders for a full-service general contractor, which PORR won. The site team was faced with a number of technical challenges, all of which were solved with ingenuity and skill.

The plan of the ground floor. It is different from the floors above. Source: PORR

Site facilities

As the site is located on the edge of a residential district, PORR attached great importance to the interests of the local residents, starting with the installation of the site facilities. The access routes to the construction site were therefore chosen in close consultation with local residents, and the number of construction site vehicles was reduced to the minimum necessary. This kept the production of noise and dust as low as possible.

The dry construction pit with old building structures, which were retained. The new basement was built into the old structure and sealed to form the white tank system. Source: PORR

Construction in groundwater protection zones

The former Windisch fine-spinning mill is located in the heart of a groundwater protection zone. Pumping and underwater construction were forbidden. Nor was it permitted to use engineering methods to ensure that the groundwater level was kept below the bottom of the construction pit until the lift shaft recesses and floor slab had been concreted. In order to be able to detect any unexpected rises in the water table with sufficient warning time, PORR therefore had to constantly monitor the water level by means of probes. A sudden rise in groundwater levels could have delayed the project indefinitely. Thanks to the well-scheduled time window, and a little luck, the entire basement could be constructed in one dry construction pit and expertly caulked to the white tank.

ENGINEERING SOLUTIONS WERE NOT ALLOWED, NOR WAS IT PERMITTED TO PUMP OUT WATER. THE WATER LEVEL WAS MONITORED CONSTANTLY.

Andreas Bart
Project Manager, PORR SUISSE AG

Exposed concrete

The specifications set by the planners for the entrance hall posed a further challenge. The ceiling over the basement is connected to the entrance hall about halfway up the rear wall. A reverse bending connection was used to avoid a visible concreting section where the basement ceiling joins the entrance hall's rear wall, and thus to connect the ceiling to the wall invisibly. In order to produce exposed concrete surfaces without horizontal joints, extra-long formwork units of 3.70 m were procured and the rear wall was concreted floor-to-ceiling in a single section.

Concrete column in the entrance hall

Due to the oversized dimensions, PORR fabricated the plate-like concrete column in the entrance hall directly on site. The columns' unusual shape meant that they could not be formed without visible joints. In order to achieve the visual result desired by the architects, the execution of the joints, types of formwork and exposed concrete classes had to correspond exactly to the specifications. The combination of a transparent resin-coated travertine floor, the bright exposed concrete walls and columns, and the drop ceiling with wall washers created a spacious entrance area.

The finished entrance hall with its striking concrete column: an invisible connection to the ceiling was facilitated using a reverse bending connection. Source: PORR

Sensitive dimensional tolerance compensation

Dimensional tolerance compensation between various subsections creates problems on many construction sites. Thorough planning was also necessary in the present case. The zigzag-shaped sheet metal building envelope, which also includes all window frames and projections and recesses for loggias, was designed on a 50mm grid. The complicated geometry and dimensional tolerances of the carcass made it difficult to precisely align the sheet metal cladding in all three axes. In a few places, despite the utmost care, additional measures were necessary to accommodate any tolerances that had arisen during assembly. The architects' scaled-back design meant that the ceilings sagged noticeably at large spans (5m). This problem was solved in consultation with the planners by installing a curtain board along the glass facade.

Instead of using a standard product, PORR manufactured all the metal facade sheets individually. Source: PORR

Ventilated metal facade

The ventilated metal facade gives the building a robust, durable and low-maintenance shell that functions perfectly in terms of the building physics. Here, PORR has broken new ground by not using the originally-intended standard product and instead manufacturing all the sheets individually. This made it easier to handle some of the complex corner details and allowed for tolerance compensation.

The carcass prior to installation of the ventilated facade. Source: PORR

Sophisticated building technology

The heating and direct hot water supply for the whole of the Kunzareal area are provided by centralised district heating. All inlets and outlets can be found in the northwest corner of the building, where they enter the white tank system through Doyma seals. Thus even here, one hundred percent impermeability of the building is guaranteed. The flats are ventilated by monoblock units. The building is certified according to the Swiss Minergie standard for sustainable construction.

The client and the contractor rely on the highest quality in the plant room as well. Source: PORR

Exterior view of the new residential building. Source: PORR

Technical data

14.560m³
Building volume

3.000m³
Volume of concrete

Gross surface area 4.618m²
Type of construction I ... Solid construction in concrete and brick
Type of construction II ..... ceilings in type 4 exposed
Concrete ..... C25/30, XC2, w/z = 0,55, Dmax. 32, C3
Reinforcing 260.000kg
Construction ..... Flat foundation; white tank system
Excavation 4.200m³
Construction pit ... partly in S3 groundwater protection zone
Building envelope I ..... Ventilated metal facade
Building envelope II ..... Extensive flat garden roof
Energy ..... District heating
Certification ..... Minergie

Summary

With the Feinspinnerei project in Windisch, PORR has constructed a modern building in a beautiful location that offers residents many extra benefits: extra-high ceilings, contemporary floor plans, and a standard of finish that impresses with many luxurious details.

PORR overcame the problems and challenges arising during construction, such as the dimensional tolerance compensation between the metal facade and structural work, in close coordination with the planners and the client, using creative and sometimes unorthodox solutions.

PROGRESS: 100% - COMPLETED
AUSTRIA/TRAUNSEE/2017-18

TURNKEY TRAINING CAMPUS

Traunkirchen Forestry Training Centre

Author: Richard Weissenböck

PORR was the main contractor for the erection of Europes most modern forestry training centre on the site of a former hospital in Traunkirchen on Lake Traunsee.

Creation of the new training campus involved the construction of two new buildings and complete renovation and conversion of the existing heritage-listed building. The client considered the preservation of the old structures to be particularly important.

Project data

Employer	Non-profit organisation Zuwo Zufrieden Wohnen GmbH
Contractor	PORR Bau GmbH
Project type	Main contractor incl. execution planning
Project scope	Construction of a training centre, renovation of a heritage-listed villa
Order volume	25 million euros
Construction start	05/2017
Construction end	08/2018

Background

In April 2017, following a multi-stage tendering process, PORR was awarded the contract to build the new Forestry Training Centre in Traunkirchen. The contract involved construction of the school building and the residential building (170 beds), together with the complete renovation of a heritage-listed former hunting lodge, where the school administration is to be housed. A combination of solid construction and timber was used for the school and the residential building. The school building also houses a sports hall (including changing and equipment room), a cafeteria including catering facilities, classrooms, seminar rooms, entrance hall and assembly hall. The residential building contains 85 bedrooms, a common room, shooting ranges, workshops and an underground garage. Two glazed axial walkways connect the three main buildings.

ORIGINALLY, EVERYTHING WAS PLANNED AND APPROVED IN REINFORCED CONCRETE. WE OBTAINED NEW PERMITS TO ADD TIMBER ELEMENTS.

Richard Weissenböck
Site manager, PORR Bau GmbH

Glazed walkways link the heritage-listed hunting lodge to the newly-built school and residential buildings. Source: Gerd Kressl

In addition to the short construction period (15 months), a particular challenge was posed by the contractual requirement to certify the campus according to the klimaaktiv Gold Standard. klimaaktiv, which focuses on energy efficiency, climate protection and resource efficiency, is Austria's best known evaluation system for building sustainability: it guarantees compliance with the highest standards. All monitoring, acceptance and testing procedures were carried out by PORR Design & Engineering (PDE); IAT GmbH, another PORR subsidiary, took responsibility for the sealing and sheet-metal work. Installation of the 100m firing lane and all work on the outdoor facilities were carried out by PORR's Civil Engineering department.

Tradition meets modernity in the dining hall located in the converted hunting lodge, now an administration building. Source: Gerd Kressl

New building permits needed

One interesting feature of the contract was the contractually-agreed requirement to obtain the final building permit. Why was this necessary? The two new buildings and connecting walkway were originally planned as reinforced concrete; these plans had been submitted and a valid permit obtained. However, the property subsequently changed owners, and the new owner, non-profit organisation Zuwo Zufrieden Wohnen GmbH, was keen to use timber structures for parts of the buildings – rendering the original building permit invalid.

Construction progress at the new training centre on Lake Traunsee in October 2017. Source: Gerd Kressl

PORR supplied all the necessary new presentation documents, certificates, timber structural designs, fire-resistance checks, etc. and obtained the new building permit needed for the timber construction. Additional permission was also obtained to create a 100m firing tunnel for long guns, which had not been included in the initial application. Another change agreed with the building authorities was the partial extension of the attic floor in the residential block.

Two weeks later: work begins on the roof truss. Source: Gerd Kressl

Complete renovation of the hunting lodge

The former hunting lodge has been adapted to a number of uses over the years. Back in the 1920s, for example, the villa was sold by the owners to the State of Upper Austria, and transformed into a lung sanatorium. Between 1973 and its closure in 2009, the building served as a special hospital for non-specific respiratory tract complaints. To prepare the heritage-listed building for its new role as an administrative building, a complete overhaul and conversion was – once again – necessary. During this process, the client attached particular importance to preserving the old structures. PORR removed the old asbestos fibre-cement tiles from the roof and replaced them with a new non-toxic double roof covering. The existing roof trusses had to be professionally overhauled, and all the original hand-cut rafters and purlins retained. Preservation of historical monuments also dictated that the windows should be replaced with wooden windows modelled on the originals.

The former hunting lodge was the home of the Buchberg state hospital from 1921 to 2009. Source: Forestry Training Centre

Spruce up and stabilise

An unpleasant surprise met the PORR workers when they exposed the old wooden ceilings: various damages meant compliance with the relevant norms was impossible.

Additional timber had to be incorporated into all the ceilings. In addition, all the gaps in the original Traunstein marble facade had to be supplemented with original material, and the facade restored to its original condition; a clock on one of the gables also needed renovation, and in addition to the above-ground work, all the drainage systems and underground pipes in the cellar were brought up to date. All covered components were fitted with fresh seals and perimeter insulation. An old arch, exposed during the renovation work, is now a feature in the newly-built bistro. Internal supporting walls on the second floor had to be removed and the ceilings underpinned with steel beams before the large dining hall could be created as required. An external emergency stairwell was built on the north side, as specified by the authorities.

Internal supporting walls had to be removed from the large dining hall and the ceilings underpinned with steel beams. Source: PORR

Stacks of wood

As a forestry training centre, the new training campus aims to stress sustainability. Consequently, timber had an important role to play as a construction material. Both the school and residential blocks were largely built based on timber structures. Where fire protection permitted, wood was also used for the walls and surfaces. Sample tests of the wooden facade and its rear ventilation were carried out at a 1:1 scale on site, inspected and approved by the architect. The wooden facade and windows have been optimised for insulation quality. The roof areas are being used to generate solar electricity. Heat is supplied from a biomass power station. The multipurpose hall and server rooms are cooled by means of heat density cooling together with the use of a spring located on the grounds. In the spirit of the klimaaktiv building standard, electric vehicle charging points have also been installed, along with bicycle stands.

All storeys and areas are connected by internal and external stairwells and lifts. A particular challenge for the planners was the design for the shooting facility in the basement of the residential building. This needed to be centrally located, but with entirely separate access, secure, and with optimal sound insulation.

Timber is the main construction material used in the canteen. Source: Gerd Kressl

Focus on sustainability

The innovative and thermally high-quality building envelope, coupled with state-of-the-art efficient building technology and the 123 kWp solar system, represents an important foundation element for the klimaaktiv “Gold” certificate. PDE supported this aspect of the project from the initial contract award through to the inauguration of the Centre. Initiatives such as building project management and optimisation of the energy technology across the entire project meant that PORR could act as a “one-stop shop” to meet all the customer’s requirements. The subsequent quality assurance was carried out via various measurements, e.g. airtightness in the spaces, quality of the air inside and sound insulation. Great collaboration between the construction site and PDE ensured that the klimaaktiv Gold Standard was achieved without significant additional effort for the contractor or extra costs for the client.

The original building is in the foreground; behind it can be seen the new timber buildings with solar panels on the roof. Source: Gerd Kressl

Technical data

15.000m³
Excavation

5.500m³
Concrete incorporated

600t
Reinforced concrete

Effective area	15,000m² over 500 areas
Plot area	3ha
Outdoor car parking	58
Underground car parking	11
Wooden walls	4.500m²
Floor slabs	2.300m²
Asphalt	4.000m²
Cross-laminated timber	2.000m³
Laminated timber	700m³

Summary

The training campus has been in full-time operation since September 2018. The ambitious deadline was only met thanks to great cooperation between all the teams on the construction site and the different subsections.

The new Forestry Training Centre. Source: Gerd Kressl

IN PROGRESS
CZECH REPUBLIC/PRAG/2018-19

TURNING AN OLD OFFICE BUILDING INTO A MODERN MEDIA CENTRE

Redevelopment of the Vinice shopping centre and offices

Author: Tomáš Kyslík, Markéta Syrová

PORR is taking on a challenging revitalisation project in the heart of Prague, which extends far beyond the scope of a typical renovation project.

In order to meet the requirements of a modern media building, only the supporting structure will be retained during the revitalisation of the old office building. Everything else is demolished and replaced by new, sometimes very sophisticated structures.

Project data

Employer	CARPET INVEST s.r.o.
Contractor	PORR a.s.
Order type	Main contractor
Project type	Building construction . Revitalisation
Project scope	Conversion and redevelopment of an office building
Construction start	05/2018
Construction end	09/2019

An extended planning process

In less than 18 months, PORR is transforming a typical 90s office building near the centre of Prague into a modern media centre. The main tenant will be a media group which, with seven TV channels and six radio stations, is one of the heavyweights of the Czech media industry.The actual revitalisation work was preceded by an unusually long tendering process, over a period of more than six months. Together with the client, PORR used this time to work closely with the building technology department to develop the optimum redevelopment plan within a set budget. A 3D model of the complex steel structures was also created together with the subcontractor in order to optimise work processes on the construction site. In addition to the pricing, this thorough preparation for the project was one of the reasons that the contract was awarded to PORR.

PORR is transforming an old 90s office building into the new home of one of the Czech Republic's leading media companies. Source: PORR

WE WORKED WITH THE CLIENT AND OTHER PARTIES INVOLVED IN THE PROJECT TO DEVELOP THE OPTIMUM REDEVELOPMENT PLAN.

Markéta Syrová
Construction Manager, PORR a.s.

Hardly a stone left standing

The building consists of three above-ground and eight basement levels. The basement floors will house an underground car park, as well as a TV studio and several storage areas and technical rooms. In addition to the lobby, the ground floor will accommodate a supermarket and a further, 600 m² TV studio. The second floor will be the beating heart of the new media building. The main entrance, main news studio, several radio stations, a café and a pizzeria will be located here. The remaining floors will consist primarily of offices and ancillary spaces. Only the supporting structure of the original building will remain. Everything else, from the exterior walls and the technical and electrical installations to the lifts and interior fittings, will be demolished and replaced. The specific requirements of the future tenant's news and radio studios are considerably higher than those for a typical renovation. For example, parts of the existing ceiling structure complete with columns will need to be removed and the new structure reinforced accordingly. The new roof is designed without columns, with the reinforced concrete sandwich panels suspended on a steel space frame. Due to the high requirements in terms of room acoustics, and the use of glazed partitions, special attention had to be paid to the airborne sound insulation.

THE CONSTRUCTION SITE IS SUPPLIED VIA AN EXISTING TUNNEL AND USING HIGH-CAPACITY CONSTRUCTION SITE HOISTS.

Tomáš Kyslík
Acquisition Manager, PORR a.s.

Logistical challenge

The location of the building on the main thoroughfare through the city, as well as the densely built-up surroundings, has made construction a logistical challenge. What's more, the supermarket needed to be operational while work on the rest of the building continued, and some of the spaces in the underground car park have been in use as public parking throughout the entire construction period.

These unusual conditions need to be considered during all of the construction activity on site. All of the construction processes need to be designed in such a way as to minimise general disruption in the vicinity of the construction site. The construction site is supplied via an existing tunnel and using high-capacity construction site hoists installed in the current building atria.

A glimpse of the future: How the building will look from September 2019. Source: GES REAL a.s.

Paving the way for the future

With the revitalisation of this office building in Prague, PORR has secured an important endorsement for future projects. It is conceivable that, over the next few years, many more 90s office buildings will come onto the market for conversion throughout the Czech Republic.

Technical data

35.000m²
Gross floor area

650
Car parking spaces

Built area	5.047m²
Upper floors	8
Basement floors	3

PROGRESS: 100% - COMPLETED
AUSTRIA/LEOBEN/2017-18

SUSTAINABILITY IN PRACTICE IN FORMER MINING CITY

Living Campus Leoben

Author: Victoria Binder

In a construction period of only 17 months, PORR built a multi-storey dormitory with student and lecturer apartments, guest rooms, start-up offices and a café.

Engaging PORR Design & Engineering GmbH at an early stage enabled efficient use of prefabricated components, while intensive planning turned the Living Campus in Leoben, Austria, into a showcase project for sustainability in practice.

Project data

Employer	Rottenmanner Bau- und Siedlungsgenossenschaft
Contractor	PORR Bau GmbH
Order type	General contractor
Project scope	Construction of a 4-5 storey residential building
Order volume	10.13 million euros
Construction start	03/2017
Construction end	07/2018

Background

As recently as just two years ago, Leoben's Brandlwiese – famous for its Autumn festival – was neighboured by a yawning expanse of emptiness. Today, that expanse is the site of a modern building providing accommodation for 280 people; not only does the structure boast a DGNB Gold Certificate, it is also an architectural highlight of this former mining city. The structure is divided into two curved axes. The shorter of the two, which stands at a height of four storeys, faces the Mur River to the west.

The main, eastern section of the building is five storeys tall. The two sections are joined by a spacious glazed atrium. Recesses in the western section have created attractive terrace areas on the flat roofs. The concept for this residential building dates back to 2015. Following two years of intensive planning and the sale of the project to the Rottenmanner Bau- und Siedlungsgenossenschaft when it was ready for construction, building work began in earnest in March 2017. PORR Bau GmbH, Styria branch acted as the

main contractor on the project. The order value was 10.13 million euros.

The Living Campus is divided into two curved axes and is situated directly beside the Mur River, in close proximity to the city centre. Source: Hermann Harg Junior

Close collaboration with PDE

PORR Design & Engineering GmbH (PDE) was involved in the project from the outset and applied their expertise to optimise the plans significantly. The structural engineering and construction management teams were decisive factors in the successful erection of the structure in its final shape using prefabricated components, brick construction and semi-finished concrete elements. This close collaboration from an early stage made it possible to maximise the use of prefabricated components, thereby minimising the need for time-consuming cast-in-situ concrete. Intensive, in-depth planning was required to achieve the highest international building certificates as demanded by the client. These considerations ranged from energy performance, resource efficiency and the origins of the building components, consumables and laying materials used through to indoor air quality, safety and comfort, as well as the ability to convert the building for alternative uses. The end result of these efforts is DGNB Gold Certification, which was officially awarded as part of the building's opening ceremony.

[TRANSLATE TO ENGLISCH:] TECHNISCHE QUALITÄT UND PROZESSOPTIMIERUNG GEHEN HAND IN HAND MIT DEM NACHHALTIGKEITSGEDANKEN.

Victoria Binder
Bautechnikerin, PORR Bau GmbH

Challenging soil conditions

No sooner had construction work begun than soil conditions and uncovered aircraft bombs delayed work to construct the foundations. To ensure that the underlying soil had sufficient load-bearing capacity, dynamic impulse compaction was carried out on the existing subsoil. A total of 320 compaction poles were used in this work, distributed across a grid beneath the flat foundations according to the Structural Engineering department's calculations. Once the soil had been stabilised, work to construct standard flat foundations could begin. No extensive excavation work was required given the relatively flat terrain; in addition, the building's single basement floor only extends beneath around one-third of the building.

From good to better

In Leoben, PORR based its plans on a structural system that had proven successful in the past and been further optimised by the construction management and planning team for this project. The external walls and the load-bearing walls in the vicinity of the staircases are composed of 25cm vertical coring bricks. As the plans were agreed at an early stage, only a small number of round reinforced concrete columns were required as load-bearing elements in the large, wing-shaped sections of the building. As a result, all structural slabs were realised joist-free using special punching shear reinforcements. .

The structural slabs are made up of loosely reinforced part-prefabricated concrete elements, which were secured to the load-bearing external walls and inset reinforced concrete columns using cast-in-situ concrete reinforcements for the full slab thickness in the punching shear area. The reinforced concrete columns were integrated in drywalls during completion work, thereby hiding them from view. These design variants had a thoroughly positive impact on both the construction period and the final project costs. To ensure that the high proportion of prefabricated parts could be handled properly on the construction site, PORR had to be integrated in planning for the building at an early stage to adapt its shape and structure to meet these requirements. In addition, construction management had to ensure smooth coordination of planning, approval, supply and delivery of concrete components.

The external walls and the load-bearing walls in the vicinity of the staircases are composed of vertical coring bricks. Source: PORR

Effective organisation

At its longest point, the building is 115m in length. To compensate for this length, three structural expansion joints were integrated in the building's structure, dividing the overall building into four construction stages. Both the construction schedule and the site facilities – and therefore, in effect, the entire construction process – proceeded according to these building sections. Construction work was first completed in the western section, before the focus shifted from the southern section to the central area and, finally, to the northern section. All subsections followed the same sequence, meaning that the northern section was the final construction stage to be completed. As the building site was organised in such a well-considered manner, only one rail-mounted fast-erecting crane was required during the entire construction period – despite the building's considerable size.

Eye-catching design

The five-storey section of the building was finished with a traditional flat roof; the four-storey section, meanwhile, features an extensive green roof, ensuring that the ideal of sustainability is even reflected on the roof. The building envelope comprises an external wall insulation system. The architect included colourful accents and window surroundings in the design for the building's façade. This lively interplay of colours is another aspect that separates the development from other buildings in Leoben and certainly catches the eye, even from a distance.

As the living spaces follow a consistent layout in terms of their dimensions and measurements, work on the building's interior was carried out both quickly and continuously in individual stages. All other subsections coordinated with drywall installation seamlessly and without significant delays.

The building features flat roofs in all areas. The shorter of the two main building sections features an extensive green roof. Source: PORR

PORR – Putting sustainability into practice

This project showed once again the importance of the topic of sustainability for the construction industry. The support from the PDE Sustainability department – from the start of the project through to handover of the finished building – ensured a high degree not only of resource efficiency and energy performance but also of comfort for the building's occupants and economic viability throughout the building's life cycle.

As the general contractor, PORR was required to place particular importance on technical quality and process quality in the execution of the project. In particular in collaborations with subcontractors, it was necessary both to specify the use of appropriate materials and products and to carefully examine and approve the materials and products used to execute the project. PORR's ability to rely on support from PDE throughout the entire construction period greatly facilitated this work. PDE served as a consultant in the project's infancy, in the planning stages and throughout the project as a whole. Furthermore, PDE conducted a life cycle assessment of the construction and usage phase and carried out all building physics examinations, tests and measurements required for the Austrian Sustainable Building Council (ÖGNI) to issue certification. This work included, for instance, daylight simulations, pollutant measurements and an on-site blower door test. This work all

had to be scheduled and the technical aspects planned during work to construct the building.

Gold Certificate

Obtaining DGNB Gold Certification not only called for clear thinking in the planning phase but also required all parties to consciously work to ensure sustainable construction work throughout the project. Intensive collaboration between the planning office and specialists from all fields involved in the project – as well as the engagement of one or two expert committees – made this sustainable vision a reality with a minimum of fuss. All PORRians involved in the building's construction can now look back on an exciting and ultimately wholly successful project.

Technical data

320 poles
Compaction poles

approx. 430t
Reinforced concrete reinforcements

Gross floor area 9.473m²
Built-up area 1.993m²
Foundation type ..... Flat foundations
Concrete used 3.969m³
Vertical coring brickwork 4.950m²
Number of apartments ... 164 single rooms, 58 double rooms
Number of offices 14
Car parking spaces 58
Bicycle parking spaces 150
Certification ..... DGNB-Zertifizierungsstufe Gold

The finished building: Living Campus Leoben. Source: PORR/Harry Schiffer

PROGRESS: 100% - COMPLETED
AUSTRIA/BÖHEIMKIRCHEN/2016-18

HARMONIOUS CONTRAST

Böheimkirchen Community Centre

Author: Markus Huber

By constructing a new community centre and renovating the old town hall, PORR has refreshed the face of Böheimkirchen town centre.

Constructing the new community centre while simultaneously renovating the town hall required well considered logistical and technical solutions. In addition architectural details also had to satisfy the Federal Monuments Authority Austria (BDA).

Project data

Employer	Borough of Böheimkirchen
Contractor	PORR Bau GmbH
Order type	General contractor
Project type	Building construction, Public buildings, offices, revitalisation
Project scope	Renovation of the listed official building and new civic centre as an annex
Order volume	9.2 million euros
Construction start	06/2016
Construction end	02/2018

Background

The notion of building a new, expanded town hall in Böheimkirchen was first mooted back in 2008. To facilitate the construction of the planned new building with a multi-purpose hall, library and police station, a plot of land was purchased at the entrance to the town centre. An international architectural competition, launched in 2012, was won by the firm NMPB. However, the modern design led to a public campaign which favoured redeveloping the old town hall over constructing a wholly new building. Following a referendum and a series of mediation meetings, the local authority backed down. In 2013, it purchased the plot of land neighbouring the town hall and the architectural firm produced a new design with a reduced space allocation plan. In September 2015, a two-stage, EU-wide call for tenders was issued with the aim of integrating as many companies from the region as possible in the project. PORR Bau GmbH, Lower Austria branch emerged as the best value bidder and secured the assignment of main contractor.

DESPITE DETAILED PLANNING, WE REACHED THE LIMITS OF FEASIBILITY DUE TO THE COMPLEXITY AND THE NARROW CONSTRUCTION SITE.

Markus Huber
Project Manager, PORR Bau GmbH

Accessible route from the market square to the parish church

The most popular motif for tourist photos in Böheimkirchen is the town hall, with its structured Gründerzeit façade and the parish church rising behind it. Until now, however, the route between the two landmarks was rather laboured. Once construction work is complete, there will be an accessible route from the market place up to the parish church. As part of this, a new steel bridge has been erected; accessible via a lift in the stairwell foyer, it is connected to the church mound and the flight of steps behind the building.

The confined building site at the heart of the town meant that sophisticated, well considered traffic concepts were necessary. A circular one-way traffic system was implemented in the centre of Böheimkirchen for the entire construction period. Large prefabricated elements, such as the hollow-core planks for the assembly room ceiling, could only be delivered on a Saturday afternoon once the regional farmer's market had finished. Any required road closures had to be requested ahead of time and publicised in the town.

The stairwell foyer in the new community centre provides an accessible route to the church mound. Source: PORR

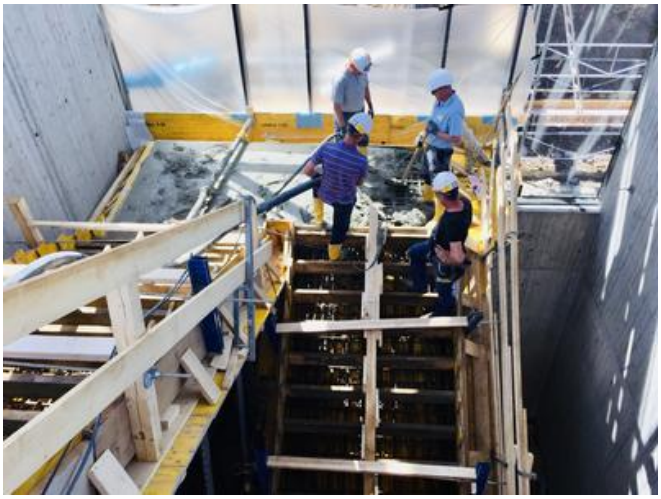
Main challenges

While renovation of the town hall was ongoing, a former confectionery shop on the neighbouring plot of land had to be demolished and replaced with a new building. Securing the old retaining wall bordering the parish church proved a particularly difficult task. After extensive survey work, PORR inserted a 14m-long pre-stressed tie-rod into the church mound.

Considerable effort went into securing the church mound's retaining wall and the structured Gründerzeit façade. Source: PORR

Foundations and structural work

Work to lay the foundations and enclose the excavation pit for the new build used in-situ concrete large bored piles with a combined length of 600m. Deep drilling work will allow geothermal energy to supply energy for the building. All storeys were planked, reinforced and concreted using in-situ concrete. The 14m-high exposed concrete walls were erected using exposed shuttering with concealed joints. The individual planed boards in the shuttering could only be used once due to the desired optics. Indeed, numerous planks were rejected for failing to meet quality requirements. In total, 9km of boards were used to implement the exposed concrete elements. A complicating factor was that these walls were erected in inclement weather conditions between December and March, and had to be protected for the remainder of the construction period.



PORR workers concrete the final flight of stairs. Source: PORR

Renovating the old town hall

To avoid damaging the array of heritage-listed elements of the old town hall, work on the existing building had to be carried out with the utmost care. Consequently, the building envelope was reinforced with a rigid steel framework construction while work was carried out. The old foundations were also strengthened, and the walls dried out in a special procedure. The old roof framework was broken down and replaced with a new steel structure. Elaborate techniques to renovate the plasterwork breathed new life into the structured Gründerzeit façade.

The new roof framework required a steel construction as the uppermost cornices of the old town hall featured a rooflight throughout. Source: PORR

Interior design

The interior spaces are an architectonic masterpiece. Wood, concrete and glass elements combine to create an extraordinary atmosphere. The oak panelling that adorns the walls and ceilings of the public spaces is also complemented by solid wood parquet flooring. Floor-to-ceiling solid wood doors provide access to the assembly room –each door weighs around 400kg. All circulation areas have been finished with polished screed, with the same concrete material used in the cast stone steps of the main staircase. The landings in the stairwells are cantilevered. All balustrades have been covered in oak cladding and feature internal LED strips.

Each of the floor-to-ceiling solid wood doors weighs around 400kg. Source: PORR

A regional project

To adhere to the regionality principle set down in the call for tenders, PORR tasked local companies with the majority of the work. Indeed, all contracts were awarded to companies based in Böheimkirchen itself or in the immediate vicinity. The individual tasks included: demolition work, earthworks, constructional steelwork, joinery, glazing, plasterwork, flooring installation, heating, ventilation, plumbing, electrical installations, window renovation, paintwork, roofing work, landscape design and a blower door test. Effective collaboration between all parties was crucial in ensuring that technical and architectonic challenges were overcome to the full satisfaction of the client. One aspect to note is that, despite the often highly demanding and technically complex work required, work on the building site was performed without any accidents.

At the opening ceremony, attended by State Governor Johanna Mikl-Leitner, Mayor Johann Hell characterised the project perfectly: “With our new building, the face of our market town has been tangibly and permanently transformed. With the courage to embrace innovation – while retaining the town’s historic structure – this project provides a focal point in the town centre. We are proud of our modern, contemporary and citizen-orientated community centre. We owe particular thanks to PORR and the team of architects at NMPB Architekten for the excellent collaboration.”

Technical data

2.500m²
Gross surface area

805m²
Plot area

1.500m³
Excavation

Construction pit depth	4,0m
Paving	400m²
Bored piles	600m
Steel incorporated	40t
Concrete incorporated	1.800m³
Reinforced concrete	220t
Exposed shuttering	600m²
Wall panelling	450m²
Baffle ceiling panelling	1.100m²
Polished screed	580m²
Post and beam façade	1.050m²

In the final weeks of execution planning, the new build was particularly striking in the evening hours. Source: PORR

MAKE YOUR HOME IN THE CITY OF FILMS

The exclusive Der Rosenhügel residential complex has an impressive historical location and sophisticated architecture. Source: PORR

PROGRESS: 100% - COMPLETED
AUSTRIA/VIENNA/2016-18

Der Rosenhügel: a residential complex in Vienna

Author: Marco Hanschitz

PORR has developed an exclusive residential complex, located on the site of the former Rosenhügel film studios.

The sophisticated architecture, with large quantities of exposed concrete, presented PORR with a number of challenges. For structural reasons, prefabricated parts could not be used for the balconies, meaning creative solutions had to be found.

Project data

Employer	Rosenhügel Entwicklungs- Errichtungs- und Verwertungsgesellschaft mbH u. Co KG
Contractor	PORR Bau GmbH
Order type	General contractor
Project type	Building construction . Residential building
Project scope	Construction of 7 freestanding buildings comprising 204 privately financed apartments
Order volume	29 million euros
Construction start	06/2016
Construction end	05/2018

Background

In 2016, Rosenhügel Entwicklungs-, Errichtungs- und Verwertungsgesellschaft mbH, a project consortium comprising UBM Development Österreich GmbH and IMMOVATE Management GmbH, awarded PORR the contract to build an unusual residential facility in Vienna's 23rd district. PORR was assigned the general contractor role for the construction of seven buildings, which would house a total of 204 privately financed apartments and be linked by an underground garage. The complex was to be developed on the large former Rosenhügel film studio site, over just two years, under the name Der Rosenhügel. The order volume for PORR came to around 29 million euros.

The new residential complex comprises seven free-standing buildings along with numerous communal facilities – saunas, fitness rooms, party areas... Source: PORR

EVEN WITHOUT USING PREFABRICATED CONCRETE PARTS, WE PRODUCED 3 KM OF BALCONY EDGE BEAMS IN DELIGHTFUL EXPOSED CONCRETE.

Marco Hanschitz
Site Supervisor, PORR Bau GmbH

Preliminary challenges

The former film studios were built between 1919 and 1923 and various parts of the site have been heritage listed since 2011, including the Synchron Stage Vienna and the first artificial light recording hall. In order to ensure that these listed buildings were protected, PORR opted for a particularly cautious back-and-forth building technique designed to avoid damages. Another challenge resulted from the construction project's location in the middle of a residential area, which complicated the coordination of material deliveries. In addition to these issues, there was a group of trees in the middle of the construction area which had to be left in place and incorporated in all the plans. They were protected with a sheet pile wall during the foundation work.

During the foundation work, a group of trees in the middle of the construction site had to be taken into account... Source: PORR

... as did the heritage-listed buildings around them. Source: PORR

Complex facade with large areas of exposed concrete.

Once the underground garage was complete, the next challenge was constructing the main buildings – complete with different numbers of storeys, variable heights, and oscillating balcony formations. The architects had designed five of the seven houses to be encircled by curved balconies made from in-situ concrete. The visible undersides of the balconies and their lateral front surfaces were to be created in exposed concrete quality. For structural reasons, it was not possible to use prefabricated concrete components to create an approximate implementation. PORR's construction site team had to find an alternative method of creating the 3 km length of balcony edge beams. The solution they came up with was to use a girder slab formwork to produce the visible balcony undersides. Around 500 structural supports and 1500 visual supports were concreted in as the carcass was created.

The formwork for the 3 km of balcony edge beams presented a particular challenge. Source: PORR

A further 300 supports were produced as cladding for the rainwater drainage system: PORR used a system of rainwater pipes which were then inserted into the visual supports. Just a cone and foundation element were concreted into the carcass. The formwork for the lateral balcony edge beams was realised using individual, adjustable mounting brackets. Using a thin formwork plate allowed for precise execution. In order to maintain the exact geometry, the team worked with a geosystem: a robotic total station. Manual placement, with the planned execution, would have caused additional tensions during the building process.

Technical data:

56.500m³
Excavation volume:

27.000m³
Concrete incorporated:

Gross floor area:	37.500m²
Usable area:	23.150m²
Site area:	15.165m²
Construction pit depth:	7m
Car parking spaces:	239
Reinforced concrete incorporated:	2.494t

Extensive safety measures

The geometrically varied, curved balconies for the individual storeys gave rise to a further task, as the formwork could not be stripped off these ahead of time. Technical and safety issues made it tricky to dismantle to a skeleton support framework before concreting the balcony floor plates on the final storey. This had a knock-on effect in the form of considerable delays to the internal finishing work and subsequent window installation.

In order to ensure that the facade work was carried out smoothly and safely, the final balcony railings were built right into the carcass. This meant that work did not have to stop for safety measures, and the use of safety nets ensured complete safety of all workers.

The completed project. Source: PORR

Summary

PORR has completed an architecturally unique project in the Rosenhügel residential complex. Despite the problems that emerged, the team was able to rise to the challenges relating to the unusual facade. The 3 km of balcony edge beams were created in delightful exposed concrete despite the restriction on using prefabricated concrete parts. Time and cost pressures were overcome and the project was handed over to the client in May 2018.

NEW LANDMARK IN THE HEART OF THE NORWEGIAN FJORDS

Die neue Loftesnes Brücke wurde für den European Steel Bridge Award nominiert, schaffte es unter die sieben Finalisten und konnte sich den Publikumspreis sichern. Quelle: PNC Norge AS

PROGRESS: 100% - COMPLETED
NORWAY/SOGNDAL/2015-18

The Loftesnes Bridge

Author: Mariusz Urbanski

With the construction of the Loftesnes Bridge, which won a European Steel Bridge Award, the PORR subsidiary PNC has realised an important project in Norway.

The contract also included the construction of a roundabout, several footpaths and cycle lanes, and the demolition of the old bridge. In order to ensure a continuous flow of traffic, the dismantling and new construction had to be precisely coordinated.

Project data

Employer	Statens Vegvessen Region Vest
Contractor	Joint Venture: PNC Norge AS und K.A. Aurstad AS
Architect	ÅF Consult
Order type	Main contractor
Project type	Civil engineering/infrastructure, Bridge construction
Project scope	New construction of bridge, roundabout and retaining wall, as well as removal of the old bridge
Order volume	238 million Norwegian kroner (25 million euros)
Construction start	12/2015
Construction end	07/2018

Background

For 60 years, the Loftesnes Bridge has crossed a branch of the Sognefjord, Norway's longest fjord. As the bridge no longer met today's technical requirements, the Norwegian road administration, Statens Vegvessen Region Vest, decided to demolish the old bridge and replace it with a new construction. The contract for the erection of a 194m steel bridge was awarded in November 2015 to a joint venture between PNC Norge (65%) and K.A. Aurstad (35%). In addition to the construction of the bridge itself, the contract also included the demolition of the old Loftesnes Bridge, the construction of a retaining wall, a roundabout, several footpaths and cycle lanes, as well as rest areas and car parks in the immediate vicinity of the bridge.

Old next to new

The new bridge was constructed in just under two and a half years, directly alongside the old Loftesnes Bridge, which had to be kept open to traffic until completion. The spatial proximity of the two structures combined with difficult ground conditions made constructing the bridge's foundations a real challenge. Ground movements and earth tremors had to be closely monitored in order to avoid negative effects on the old bridge while 28 tubular steel piles were driven into the fjord bed to serve as supports for the main foundations.

By August 2016, two main foundations had been constructed, each with 14 piles. The piles were driven by a barge-mounted pile driver. A total length of almost 1,500m of piles were sunk into the sea, reinforced and cast on site. The longest pile was over 70m long.

The piles being driven. In the background, 14 fully installed piles for another foundation can be seen. Source: PNC Norge AS

The old bridge was in use until the new bridge had been completed. Source: PNC Norge AS

By August 2016, two main foundations had been constructed, each with 14 piles. The piles were driven by a barge-mounted pile driver. A total length of almost 1,500m of piles were sunk into the sea, reinforced and cast on site. The longest pile was over 70m long. After the pile work, the construction of the pile caps and two abutments at each end of the bridge could begin. During this time, the steel structure for the bridge, consisting of three sections and weighing almost 1,300 tonnes, was manufactured in Poland. At the end of January, after the pile caps and abutments had been completed, all three steel sections were loaded onto two barges, secured and shipped to Norway, where they arrived five days and 765 nautical miles later.

THE CRITERION FOR THE AWARD OF THE CONTRACT WAS THE LOWEST PRICE. WE WERE ABLE TO ADD THE BEST QUALITY TO THAT.

Mariusz Urbanski
Project Manager, PNC Norge AS

Assembly by floating crane

The arrival of the steel structure and the subsequent assembly of the bridge marked the start of the most exciting phase of the project, which was also watched with great interest by the locals. Residents and onlookers gathered on the quay where the steel structure was delivered to follow the construction process. PNC had precisely planned each step of the actual assembly in advance and created a detailed schedule.

A floating crane with a load capacity of 800 tonnes was used to assemble the three bridge sections. By 31 January, the first steel structure, weighing 470 tonnes, was suspended from the crane and assembled in its final position. Just four days later, the other two parts were also in place. The installation of one section very close to the old bridge necessitated its closure to traffic for a short time for safety reasons.

Dismantling and new construction in parallel

Before the old Loftesnes bridge could be dismantled, traffic had to be switched to the new bridge within a timeframe specified by the client. This meant that the roundabout had to be constructed and all surfacing works completed. PNC made every effort to meet this deadline, since each day of delay would have resulted in a substantial penalty.

Intensive work on the completion of the bridge deck was carried out during the summer of 2017, in order to take advantage of the good weather conditions for insulation and asphalting works. The insulation layer was applied to the bridge deck and the roundabout at the end of September 2017, followed two weeks later by the asphalt. The bridge was opened to traffic on 29 November, one day before deadline.

THE NEW BRIDGE CONSISTS OF A THREE-PART STEEL STRUCTURE, WHICH WAS ASSEMBLED USING AN 800 TONNE FLOATING CRANE.

Mariusz Urbanski
Project Manager, PNC Norge AS

Work to dismantle the old bridge began immediately afterwards, using heavy lifting equipment to divide it into three sections that were brought ashore on a barge. Then the construction materials were separated and prepared for recycling. The piles sunk in the fjord were cut by a team of divers. The entire dismantling process took around one and a half months.

A bird's eye view of the bridge after completion of the works.
Source: PNC Norge AS

Technical data

194m
Bridge lengths

1.000t
Reinforced concrete

Piles driven	28 piles, 1220mm, max. length 70m
Steel incorporated	1.250t
Concrete incorporated	6.600m³
Tie cables	72 fully locked cables, 45mm

Successful handover and award

After the old bridge had been dismantled, the last phase of the project started. The remaining parts of the abutment, steel structure and bridge deck could now be finished. The welding of the steel structure and the application of corrosion protection to it were both performed on site. While PNC put the finishing touches to the bridge works, the joint venture partner K.A. Aurstad took care of the planting, finishing the footpaths and cycle paths, and the electrical installations. After a successful inspection, the bridge was handed over to the client in July 2018. The project's crowning achievement was winning the ECCS Public Award in the "European Award for Steel Structures" competition.

To make the shore accessible, the town of Sogndal invested in a fjord hiking trail with play equipment, fitness equipment, seating and sculptures. Source: PNC Norge AS

PORR'S BIGGEST CONSTRUCTION SITE

The lining segments in the north tunnel are constructed as a single-skin finish. Source: Harry Schiffer

IN PROGRESS
AUSTRIA/2013-22

Koralm Tunnel, Construction section 3

Author: Sebastian Dietrich

Since November 2013, PORR has been boring through the layers of the Koralpe Massif bedrock, drilling the Koralm Tunnel project into reality.

The contract covers the construction of 2 tunnels with 21km total length. In the south tube, an existing exploratory tunnel has been extended in riverbed/soil advance, while a tunnel boring machine named “KORA” is pushing its way through the north tunnel.

Project data

Employer	ÖBB Infrastruktur AG
Contractor	PORR Bau GmbH
Order type	General building works
Project type	Civil engineering/infrastructure, Tunnelling
Project scope	Creation of a 2 tunnels with a total length of 21km
Order volume	297 million euros
Construction start	11/2013
Construction end	08/2022

Background

The Koralm Tunnel (KAT), scheduled to open in 2025, will establish a link between two Austrian state capitals: Graz and Klagenfurt. The project can be listed alongside the Brenner Base Tunnel and Vienna Central Station as a key element of the Baltic-Adriatic corridor, which links Danzig in Poland with Ravenna, Italy. The Koralm Tunnel has two tunnel tubes lying 25m to 50m apart and connected by cross passages every 500m. In 2013, Austrian railway company ÖBB Infrastructure AG awarded the contract for the third and final construction section, KAT3, to PORR Bau GmbH. This major project involves construction of the two tunnel tubes with a total bore length of 21km. With an overall order volume of 297 million euros, KAT3 currently represents PORR’s largest construction site.

FOR THE SOUTH TUNNEL, THE EXISTING EXPLORATORY TUNNEL WAS WIDENED TO THE FULL PROFILE OVER A LENGTH OF MORE THAN 7 KM.

Sebastian Dietrich
Project head, PORR Bau GmbH

Three geological zones

From a geological point of view, the construction section can be divided into three distinct zones. For the first 4km or so, the PORR miners bored through sedimentary rock from the Neogene period, alternating between clay, silt and gravel. This was followed by a 400m stretch through the main Lavanttal fault before reaching a crystalline section of fine-grained gneiss, mica schist and marble that extended to the end of the construction section.

Varied advance techniques

Work has been ongoing on both tunnels since November 2013. The team began in the Lavanttal in Carinthia and is boring through the Koralpe Massif towards Styria. The north tunnel is being bored throughout its 10,474m length by the “KORA” tunnel boring machine (TBM). The conventional drilling & blasting and excavating technique was used for the south tunnel. There was an existing exploratory tunnel around 7,000m long here; this has been extended downwards, so that the exploratory tunnel forms the upper two-thirds of the final cross-section, i.e. the tunnel dome. The bottom third, the side walls and tunnel floor, are the result of this widening process. For the remaining 2,700m to reach the edge of the construction section, the full cross-section was bored. The cross passages between the north and south tunnels are being created at 500m intervals via cyclic advance: excavation/drilling & blasting.

Complex, challenging logistics

Right at the beginning of the work, once the full face had been driven through, a dismantling cavern had to be built at the end of the construction section, where the TBM from the neighbouring construction section would be dismantled. A crusher and conveyor system were installed during the advance to tunnel metre (TM) 7,000, in order to be able to complete the drill & blast advance all the way to the boundary of the construction section.

A crusher and conveyor belt system up to the construction section boundary had to be maintained from TM 7,100 up to TM 9,826 and the dismantling cavern, even once the full-face excavation had been completed. This meant that the various machine modifications became very costly and the cyclic drill & blast and excavation advance was more challenging – after all, normally the tunnel would be driven from the portal to the end of the construction section or breakthrough point in a single pass.

The PORR team was challenged by the ambient conditions, as well as by the complex logistics. The high overburden of up to 1,200m in this section meant that at times the temperature reached 31 degrees. The fresh air supply, provided by an airtight pipe, was therefore supplemented with a cooling system.

The excavated material from the drilling & blasting was processed on-site by a crusher and transported away via a conveyor system. Source: Toni Rappersberger

Widening in the crystalline and Neogene zones

In the next section of advance, the existing exploratory tunnel running from TM 4,400 to TM 7,098 was widened, once again using drilling & blasting. The excavated material was then transported out via the crusher and conveyor belt system.

The side wall and tunnel floor advance then continued from the portal to TM 4,400. Due to the challenging geology, preliminary drainage measures were necessary in some sections: boreholes in the existing dome cross-section were extended in advance and placed under a vacuum. In some areas, up to 570,000l was shifted within 24 hours.

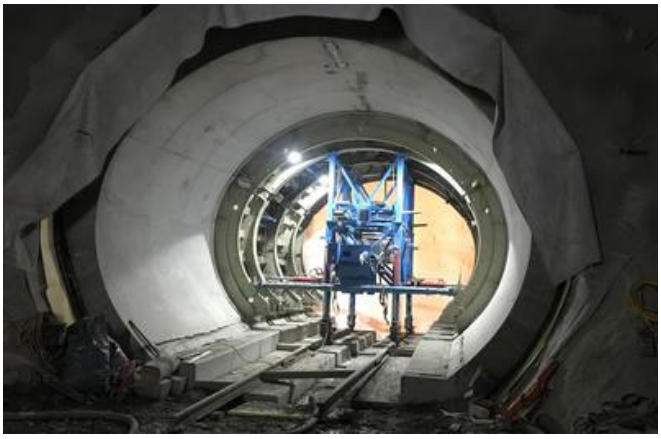
In the Neogene zone, a Jetcrete dome invert had been installed along the full length of the exploratory tunnel. This invert was removed using an extra tunnel excavator with a cutting wheel, an innovative solution which represented a significant optimisation for the tunnel boring process, as it meant that cutting could be largely carried out independently of the time-critical path.

The existing dome invert was cut out in advance using a tunnel excavator with a built-in cutting wheel. Source: PORR

The cross passages

The passages linking the two tunnels were constructed in parallel with the cyclic advance through the south tunnel. The lining segments through the Neogene zone were shored up with steel reinforcement. In order to take the forces until the in-situ concrete inner lining had been installed, the upper and lower reinforcement traverses were pre-tensioned using presses over the supports; these were retained until the solid reinforced lining block had reached the required strength. The steel reinforcement was then removed, transported to the next cross passage, and reassembled.

Before breaking through for the cross sections, the lining segments in the Neogene zone were shored up with steel reinforcement. Source: PORR AG



The tunnel invert and roof were concreted after installation of the membrane seal. Source: PORR

The north tunnel

The north tunnel was mainly bored with the “KORA” tunnel boring machine. The cyclic method was only used for the (568m) approach tunnel and (70m) start tunnel. “KORA” was assembled in the Mitterpichling construction pit; the trailing support was assembled at the west portal and pushed through the approach tunnel.

Once the TBM had been assembled, the advance began from the end of the start tunnel. The Neogene section was bored with the TBM, using earth pressure balance shielding, or EPB. This is a system where the excavated material is broken down and conditioned to act as a plastic support medium. The excavated material is transported with an auger to the subsequent conveyor belt. The team confronted significant obstacles during the advance through the

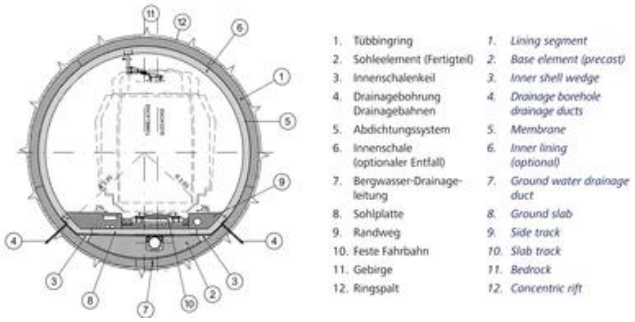
Neogene zone. The greatest delay resulted from extensive maintenance works to the cutting wheel carried out during summer 2016. Successful completion of the first section, the Neogene zone, was marked by the breakthrough to the Paierdorf intersection. Next, in between the Neogene and crystalline zones, the main Lavanttal flow had to be pierced – this covered a length of almost 430m. This section consisted of fault rock and extremely high strength blocks that affected the performance of the TBM to such an extent that it was decided to use a cyclic advance technique for part of the main Lavanttal flow, with a counter-approach from the south tube: this would save on construction time.

The “KORA” TBM was assembled in the Mitterpichling construction pit. The drill bears the Carinthian state colours. Source: Toni Rappersberger

After the breakthrough, the TBM was converted underground into hard rock mode. The drill head was adapted for the crystalline section and the conveyor system for the excavated material was replaced with a Muckring conveyor and belt removal system. The crystalline zone represents the hardest bedrock in the Koralm Massif. Apart from a few individual fault zones, where strengthening measures were carried out starting from the south tunnel, the advance is currently progressing through hard rock.

Inner lining and finish

Once the advance is complete, work can begin in both tunnels on installing a drainage system, membrane and inner lining. The lining segments in the north tunnel are being constructed as a single-skin finish. An additional inner lining is therefore only being installed in certain sections, such as fault zones. The carcass will be complete after the crack-limited ground slabs, side tracks and shoulders are installed.



A highlight of every tunnel construction project: the breakthrough – here at the Paierdorf intersection. Source: Harry Schiffer

A highlight of every tunnel construction project: the breakthrough – here at the Paierdorf intersection. Source: Harry Schiffer

Technical data

7,4t
Weight of segment stone

48t
Weight of complete ring

14t
Weight of base element

Machine name	S-857 – „KORA“
Nominal diameter	9.940mm
Shield length	10,760m
Installed power/drive power	7.200kW / 4.200kW
Length of TBM + trailing support	250m
Weight of TBM + trailing support	2.475t
TBM advance length	10.474m
Number of segments	5.500
Segment system	Universal ring, sealed
Segment thickness	35cm
Segment width	1.90m
External ring diameter	9.500mm
Internal ring diameter	8.800mm
Machine type	Multi-mode TBM

THE KORA TUNNEL BORING MACHINE WAS CONVERTED UNDERGROUND FROM EARTH PRESSURE BALANCE SHIELD MODE TO HARD ROCK MODE.

Sebastian Dietrich
Project head, PORR Bau GmbH

Historic milestone

In August 2018, the breakthrough of the south tunnel marked one of the most important milestones for the Koralm centenary project. At that time, there were less than six kilometres to go before the second breakthrough to the north tunnel. KORA will execute the complete breakthrough of the Koralm Tunnel after these remaining kilometres.

The north tunnel is mainly being bored using the “KORA tunnel boring machine”. Source: Harry Schiffer

IN PROGRESS
SWITZERLAND/KANTON GRAUBÜNDEN/2015-20

ON THE CREATION OF A HIGH MOUNTAIN TUNNEL

New construction of the Albula Tunnel II

Author: Klaus Eder

In the Swiss canton of Graubünden, PORR is working on one of the highest underground Alpine passes: the Albula tunnel, 6km long and 1,800m above sea level.

Its exposed construction site and the technical conditions been stretching the PORR tunnelling team to their utmost for the last three years. The diverse geological formations in particular had a few surprises up their sleeve.

Project data

Employer	Rhätische Bahn AG
Contractor	Neubau Albulatunnel II consortium: PORR SUISSE AG, Walo Bertschinger AG, Società Italiana per Condotte d'Acqua S.p.A.
Project type	Civil engineering/infrastructure, Tunnelling
Project scope	New construction of the approx. 6km-long Albula Tunnel II
Order volume	CHF 125 million approx. (EUR 110 approx.)
Construction start	2015
Construction end	2020

Background

The railway line from Thusis to St. Moritz is 62km long; its 42 tunnels and 144 bridges span altitude changes of over 1,000m in total. The Albula Tunnel, first operated in 1903 and awarded UNESCO cultural heritage status in 2008, forms the centrepiece of the route. However, at over 110 years old, the tunnel is exhibiting significant technical defects. In 2006, rather than carry out extensive renovations on the old tunnel, the Rhätische Bahn opted to build a new tunnel – the cost difference would be minimal and less disruption to the ongoing rail operation would be caused; furthermore, with the new build, it would be easier to address modern safety requirements.

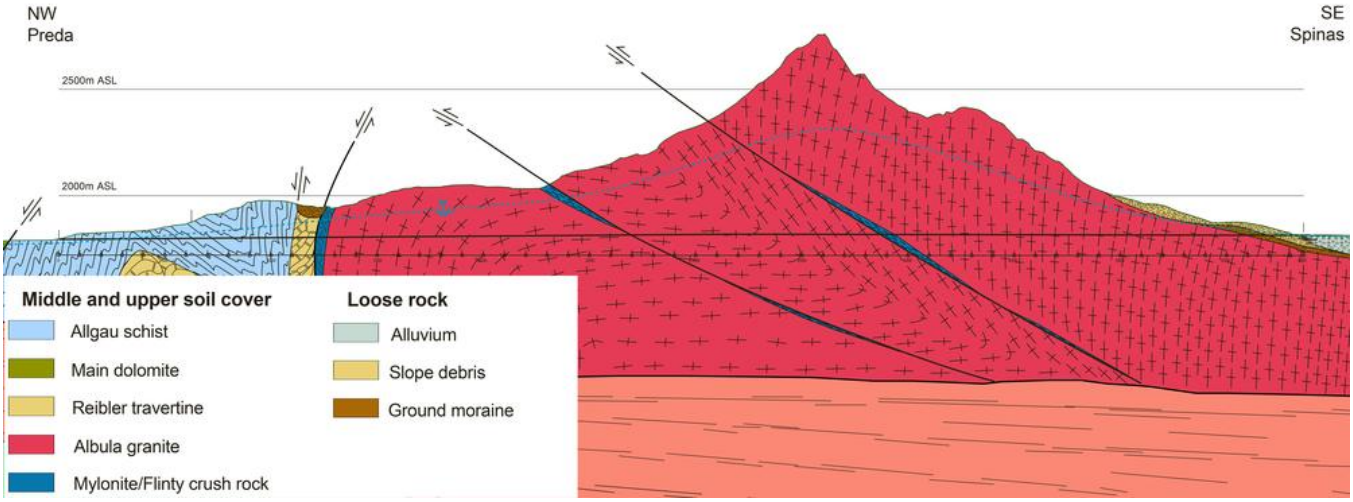
The contract to build the new tunnel was awarded in the winter of 2014/2015 to a consortium led by PORR SUISSE AG and also consisting of Walo Bertschinger AG (Switzerland) and Società Italiana per Condotte d'Acqua S.p.A. The order volume is around CHF 125 million (EUR 110 million approx.) Handover of the tunnel was originally scheduled for August 2019. However, due to the geological conditions encountered, the tunnel boring work took about a year longer than anticipated.

Comprehensive preliminary work

Before actually beginning work on the tunnel boring, extensive preliminary work was necessary. The consortium set to work on the two installation sites in Preda and Spinas, constructing office blocks, temporary accommodation for 65 people, watercourse protection facilities to purify the waste water from the tunnel, two concrete plants, workshops for equipment repairs, and a gravel plant for processing the excavated material. The construction site is closed between December and March and can only be reached by train, as the pass road between Bergün and Preda is closed and used as a toboggan run. The contract specifies that all bulk goods must be transported to the site by railway.

Tunnel boring

Boring took place via two approaches: from the north (Preda) and the South (Spinas). The narrow cross section in the single-track tunnel – a mere 35m² – entailed a carefully designed equipment plan. Still, at first glance the actual tunnel boring seemed almost negligible compared to the enormous logistical and technical challenges of preparing the equipment and setting up the construction site. In fact, however, the diverse geological formations were harbouring a few surprises for all the project participants.

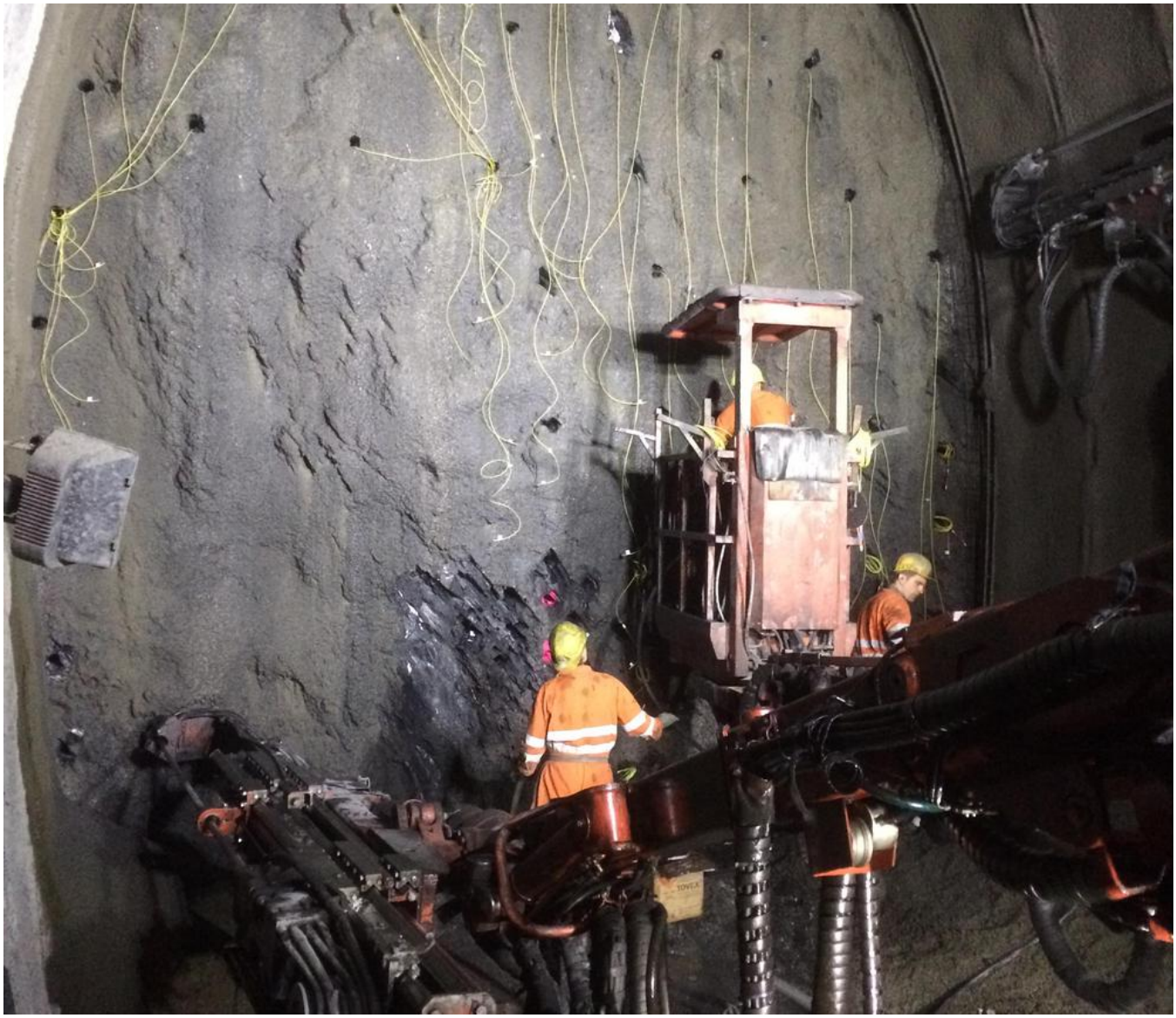


The longitudinal geological profile shows the different rock formations. Source: Sieber Cassina + Handke, Chur

Excavation work from Preda started off in loose stone for the first 37m, protected by four pipe screens. Due to large numbers of storms and low stone stability, this area had to be excavated with a tunnel excavator. After this, a section of Allgäu schist followed, where it was possible to switch to drilling and blasting. However, the dark fine slate proved to be very loose, with a strong tendency to form silt when subjected to mechanical load and water. Water ingress volumes of 45l/s gave the watercourse protection facilities their first serious test. Over successive stages, it was necessary to make up to 50 injections into the open face, at intervals of 15m, to stabilise this area.

The most challenging area from a construction point of view was the Raibler formation. The Raibler travertine geology consists of porous dolomites with hollow cavities. This matrix contains foreign components containing schist, limestone and granite, along with silt containing gypsum. When the first Albula Tunnel was being constructed, a flood of silt forced the construction company into bankruptcy, and the construction site lay abandoned for a year.

This time around, the section was divided into three zones, with the unfavourable third section being protected by a frozen foundation. A chamber was used as the start point for creation of the freezing zone and the reverse-drive in this section, while the first two zones were excavated using a conventional excavator. This section also required sophisticated safety measures – working face anchors, injections, skewers and shotcrete – and, as a result, the average advance was reduced to a mere 95cm per day. In the light of the investigatory results and repeated changes to the execution planning, the client agreed a payment plan for the excavation work that would not be tied to the performance. The greater length of the tunnel blasting was carried out in Albula granite. The high degree of wear on the drilling tools and sharp rock separations kept the teams fully occupied.



In the Allgäu schist section, it was possible to switch to drilling and blasting, but the dark fine slate proved to be very loose, with a tendency to form silt. Source: PORR

Both pipe screens and excavation supports were used for the first metres of advance in Spinas. A rock collapse in the 250m-long loose stone section caused boring to be halted for a month. Around 500m³ of mud and rock made their way into the tunnel from the ridge, and we were fortunate that nobody was injured. Extensive injections of foam and cement were needed before the sections could be stabilised and cut through. A granite blasting process followed in the next section, with each blast being carried out in a blast window agreed in advance with the rail operator. The small distance to the existing pipes meant that the permissible vibrations could not exceed 60mm/s. Despite these restricted conditions, the consortium was able to achieve a performance of 20m per working day. An important milestone was reached on 2 October 2018, when the machine broke through to the Preda advance.

The railway line in Spinas continued operating during the pipe screen advance. Source: PORR

FOR THE MOST TECHNICALLY DEMANDING PART, WE DIVIDED THE CONSTRUCTION SITE INTO DIFFERENT ZONES.

Klaus Eder
Deputy site supervisor, PORR SUISSE

Material processing

Since the tunnel boring was carried out from two sides, the material, having been pre-crushed in the tunnel, had to be transported by rail from Spinas to Preda. Depending on its quality, the stone was either processed for concrete aggregate and rail ballast, or incorporated in the inert substances landfill on site. The gravel plant operated by the consortium is able to process up to 4,000t of excavated material each week. These are then processed by the construction site's concrete plants, producing shotcrete and structural concrete for the tunnel carcass.

At present, work on the tunnel advance sealing is in progress; this will prevent mountain water from penetrating into the inside of the tunnel. In early 2019, the internal finishing work will begin, and is expected to continue until the end of 2020.

The consortium operates a gravel plant in Preda, which can process up to 4,000t of excavated material each week. Source: Torsten Schaarschmidt, Pöyry Schweiz AG

Loud cheers were heard after successful break-through of the Albula tunnel. Source: Andy Mettler, Swiss Image

Technical data

5.860m
Tunnel length

60.000m³
Concrete

Height above sea level	1.800m approx.
Solid excavation volume	230.000m³
Cross-links	12 (3 with vehicle access, 9 pedestrian)
Anchors installed	22.600 approx.
Explosive used	800t

Other special features

- **Geological conditions:** Albula granite, Allgäu schist, travertine, loose rock
- **Boring methods:** Conventional tunnel boring (excavator, drill and blast)
- **Finishes:** Inner shell from structural concrete (double-skin area) shotcrete finish (single-skin finish)
- **Special features:** Tunnel boring during railway operation, annual 2.5-month winter break due to toboggan run on the access road

Successful interim report

Despite often difficult and dangerous conditions, in spring 2018 the construction site was able to celebrate 500 days without any occupational accidents. This was only made possible thanks to the untiring dedication that all our employees bring to their daily work – or perhaps we should say, which forms a foundation for their daily work.

PROGRESS: 100% - COMPLETED
AUSTRIA/VIENNA/2018-18

A BEACH IN THE HEART OF THE CITY

The CopaBeach on the Danube Island in Vienna

Author: Constanze Mitterer

The CopaBeach in Vienna is to be transformed into a modern local resort in three construction phases. PORR completed the demanding first part in record time.

As full-service contractor, PORR was responsible for the execution planning for this project on the banks of the New Danube. The geometry of the double-curved three-dimensional retaining walls and the tight schedule were particularly challenging factors.

Project data

Employer	Wiener Gewässer Management GmbH
Contractor	PORR Bau GmbH, Lower Austrian branch
Order type	Full-service contractor
Project type	Civil Engineering/Infrastructure, Civil Engineering
Project scope	Restructuring the riverbank and ensuring accessibility by means of construction elements consisting of retaining walls and ramps
Order volume	2.2 million euros
Construction start	01/2018
Construction end	06/2018

Background

In the 1980s, the Danube River was regulated and the resulting spoil was built up to form the Danube Island. This created the New Danube, which was to become a popular local resort for Vienna residents. Over time, the “Copa Cagrana”, a popular area, came into being in the immediate vicinity of the Reichsbrücke bridge. The City of Vienna is now restructuring and modernising this section, which has seen better days, in three construction stages. An EU-wide architectural competition was held, and the winning project features a redesign of the shore which, in addition to a contemporary, visually appealing surface design, also fulfils the original function of a flood protection measure on the left bank of the Danube.

At the beginning of January 2018, PORR Bau GmbH, the best bidder, was selected by Wiener Gewässer Management GmbH as full service general contractor for the construction of the first section, the CopaBeach. The structural analysis, which was included in the order, and the execution planning were both carried out by PORR Design and Engineering GmbH.

Planning and demolition

The main challenges presented by the project were the unusual geometry of the special retaining walls and the tight schedule. After all, the city beach had to be completed in time for the bathing season. In addition, the investor came up with the idea of showing the FIFA World Cup at the newly designed CopaBeach in June 2018, and applied for the necessary permits. The PORR construction site team had to create the appropriate infrastructure for public viewing, and factor this into their schedule.

The first step, clearing the construction site, involved demolishing the numerous existing steps and retaining walls. All the built-in elements were removed and the terrain was reprofiled and restructured to ensure accessibility. This entailed moving approximately 11,800m³ of earth, of which roughly 6,600m³ were removed entirely.

The public viewing of the World Cup, scheduled for June 2018, determined a clear time-line for work on the first construction stage. Source: PORR

Double curves in three dimensions

While the demolition works were going on, PORR drew up the execution plans for the new retaining walls, which display a high degree of technical complexity due to their "double-curved three-dimensionality". A total of five retaining walls were erected on the construction site to accommodate the difference in height along the embankments on the left bank of the Danube.
The largest construction element is the SM-1 retaining wall, which begins at the quay of the New Danube at a height of 3.50m above the top edge of the foundations and becomes increasingly lower before tapering off at the upper edge of the embankment. Seen on the plan, the SM-1 describes an irregular curve before ending in a straight line. The cross-section of the foot of the supporting wall foot is also curved. The SM-1 winds continuously back and forth from the quay before merging into a stairway after 2/3 of its total length. The other retaining walls also feature irregular curves in several directions, but are consistently lower.

PORR erected several retaining walls featuring irregular curves along the embankment area. The largest retaining wall begins at the quay and ends at the top of the embankment (visible in the background). Source: PORR

NO HANDLE WAS THE WAY IT ALWAYS WAS. HARDLY RECOGNIZABLE TO THE LAYMAN, BUT THE PROJECT WAS TECHNICALLY CHALLENGING.

Constanze Mitterer
Site manager, PORR Bau GmbH

Unique exposed concrete

For the most part, the architectural concept for the retaining walls specified exposed concrete, coloured yellow and containing a proportion of white cement. During sampling, the aggregates played a decisive part in selecting the concrete that was to be used. Each exposed concrete surface required a custom-made piece of formwork, which could only be used once per square metre.

Custom-made formwork was needed to produce the exposed concrete surfaces. Source: PORR

Equipped for emergencies

Additional design elements were used when creating the pathways on the embankment. For example, rectilinear retaining walls made of precast concrete elements were fitted with seats, different levels were created in the green spaces and along the footpath boundary lines using Corten steel, and a 500m² sandpit was installed.

Since the construction site is located in the flood run-off area of the New Danube, the unpaved areas of the embankment were secured with grass pavers up to flood mark HW100 plus 1m, and covered with humus. The CopaBeach catering outlets are housed in mobile facilities so that they can be removed at short notice in the event of flooding. In a final step, 6,500m² of turf were laid out, making the new local recreation area ready for use ahead of time.

Technical data

11.800m³
Earth moved

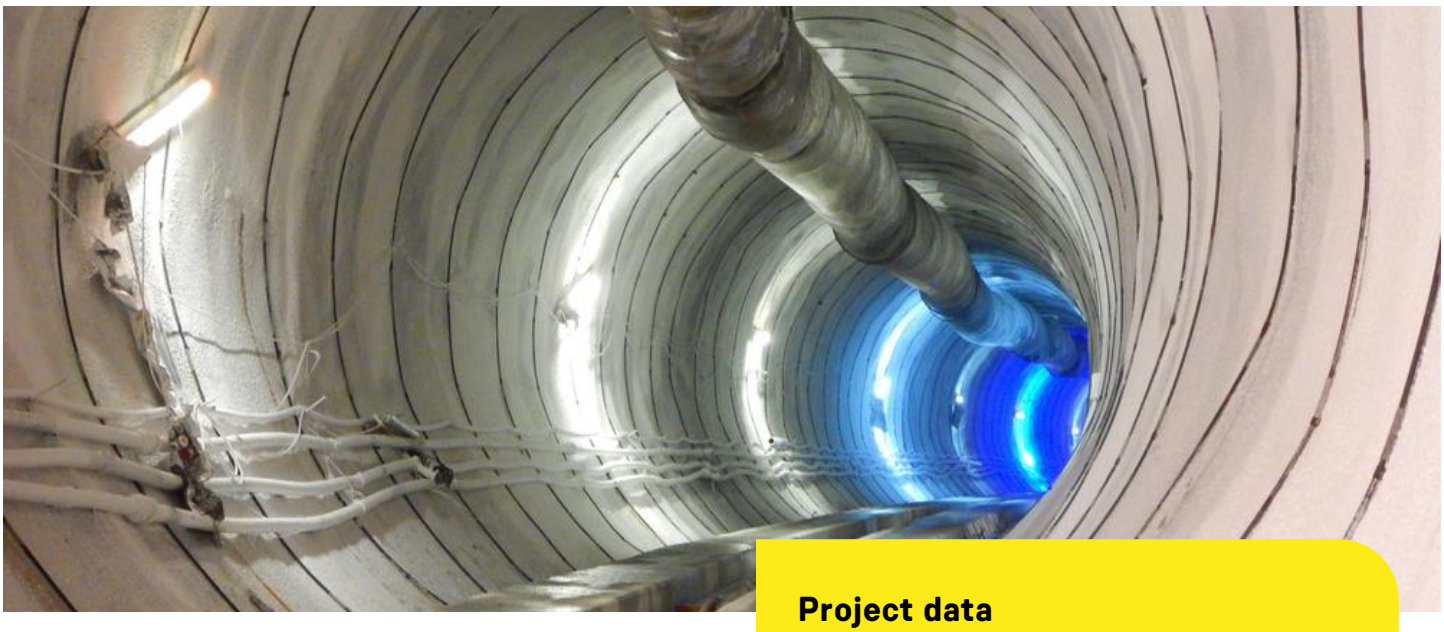
6.600m³
Excavation

1.590m²
Formwork

Site clearance	13.000m²
Demolition	7,700t concrete; 1,400t asphalt
Custom formwork, curved	720m²
Total concrete	930m³
Exposed concrete	395m³
Turf	6.500m²

A challenge for the team

The technical complexity and tight schedule of this unusual construction project presented a challenge for the project team during every stage of the construction – designing the formwork and reinforcements, construction preparations and, ultimately, the execution. Nevertheless, PORR managed to overcome the technical challenges within the scheduled construction period.



PROGRESS: 100% - COMPLETED
AUSTRIA/ALPS (SWISS-AUSTRIAN BORDER)/2014-18

RIVER INN JOINT POWER PLANT ON THE SWISS-AUSTRIAN BORDER

Largest run-of-the-river power plant in the Alps

Author: Robert Wachter

Led by Hinteregger, the GKI Prutz Bau consortium constructed a powerhouse and penstock for the River Inn joint power plant in Prutz.

The underground construction work proved particularly challenging: the team faced steep gradients and tricky geological conditions. The completed diversion hydropower plant will generate around 400 gigawatt hours per year.

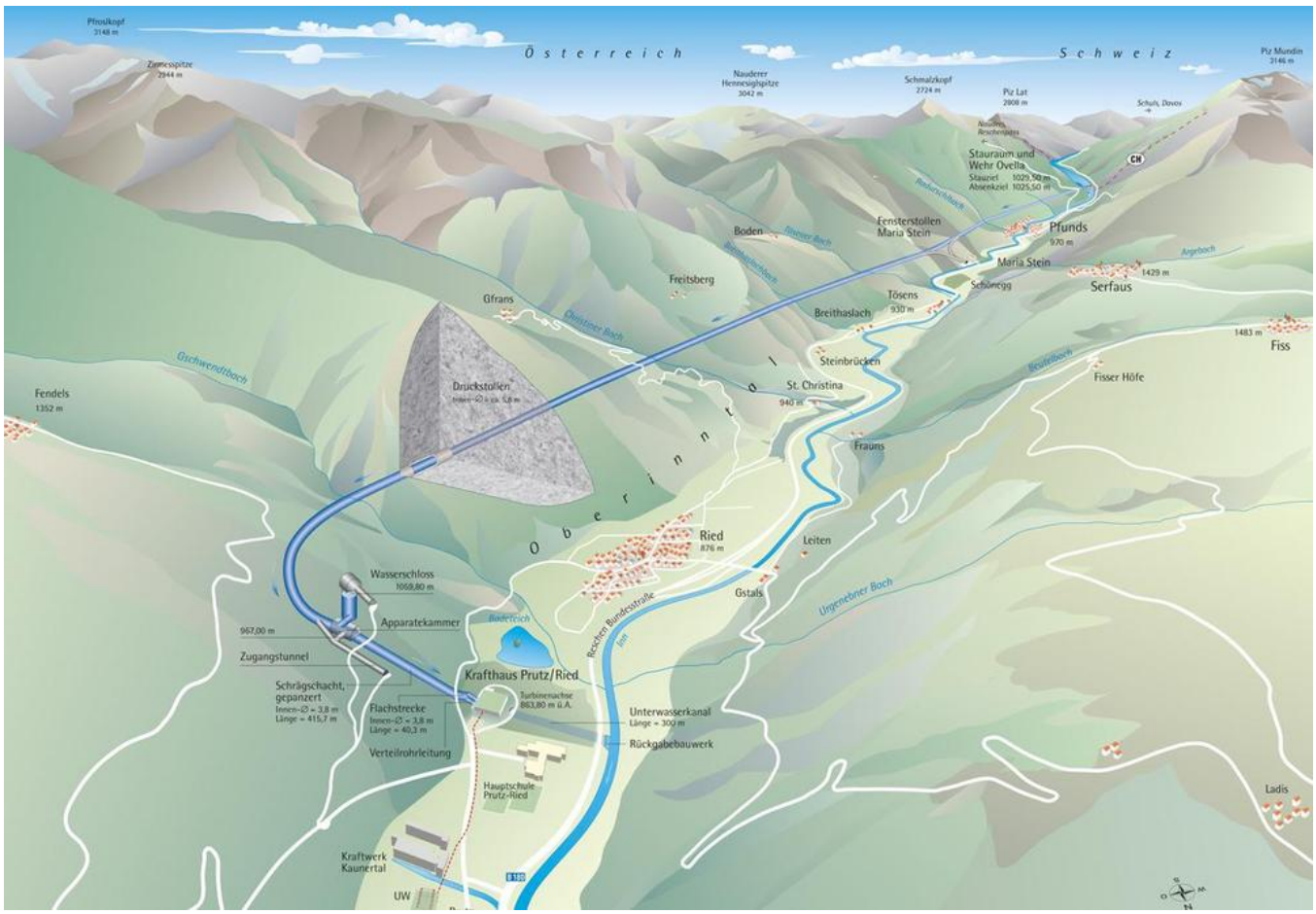
Project data

Employer	GKI GmbH
Contractor	GKI Prutz Bau consortium: G. Hinteregger & Söhne Baugesellschaft m.b.H, ÖSTU-STETTIN Hoch- und Tiefbau GmbH, BeMo Tunneling GmbH, Wayss & Freytag Ingenieurbau AG
Order type	Construction work
Project type	Civil engineering/infrastructure, Tunnelling
Project scope	Construction of a penstock including powerhouse and underwater channel
Construction start	07/2014
Construction end	10/2018

Background

The first plans to exploit the water power from the Upper River Inn date back to the nineteen-twenties. When plans for a power plant were reintroduced in 2003, the project was brought up to date with the current state of the art and environmental standards. The cross-border location between Austria and Switzerland meant that not one but two environmental impact assessments were required. In 2013, with the assessments successfully completed, the client – a joint venture comprising TIWAG and Engadiner Kraftwerken – put out the call for tenders to construct a diversion hydropower plant with an annual output of 414GWh.

The construction contract for the Prutz construction lot was awarded to the GKI Prutz Bau consortium, led by G. Hinteregger & Söhne Baugesellschaft m.b.H.; Hinteregger was also involved in constructing the headrace running from Maria Stein.



The River Inn joint power plant is built on the border between Austria and Switzerland, in the Upper Inn Valley. Source: GKI GmbH

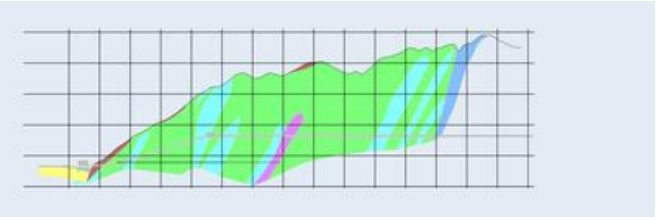
The power plant

By 2021, the River Inn joint power plant (In German, Gemeinschaftskraftwerk Inn, or GKI), located on the Upper River Inn on the Swiss-Austrian border, will represent the largest new power plant in the Alps for many years. The core of the project is a weir system with a head of around 15m, and behind it a retention area with a length of 2.6km and storage space of around 900,000m³. The intake from the headrace tunnel is located on the right-hand side of the weir system, looking downstream. Up to 75m3/s of water is diverted from the retention area into the headrace for electricity generation. The water travels through the headrace tunnel, which is being developed from an intermediate heading in Maria Stein, to the nacelle, or powerhouse. It 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 86.9 MW.

The main work in the Putz construction lot involves constructing the powerhouse, open cut construction of the underwater channel, and the underground work for the 1.5km-long headrace. The underground work includes the dismantling chamber, driving the headrace tunnel from both ends using conventional methods, building a link tunnel to the surge tank and surge shaft, the valve chamber and the inclined shaft for the penstock, including a horizontal section.

Geological conditions

Site development began immediately the contract was awarded. The necessary roads had to be built in tight spaces while contending with challenging geology. The grey Bündner schist with sericite mica and limestone phyllites that makes up most of the Lower Engadin window is classed as brittle. While very little mountain water ingress was recorded across the whole advance area, increased water ingress was recorded in the reverse drive area from the point of transition from phyllites to calcareous slate.



The Prutz construction lot geology is dominated by grey Bündner schist (green area). Source: GKI GmbH

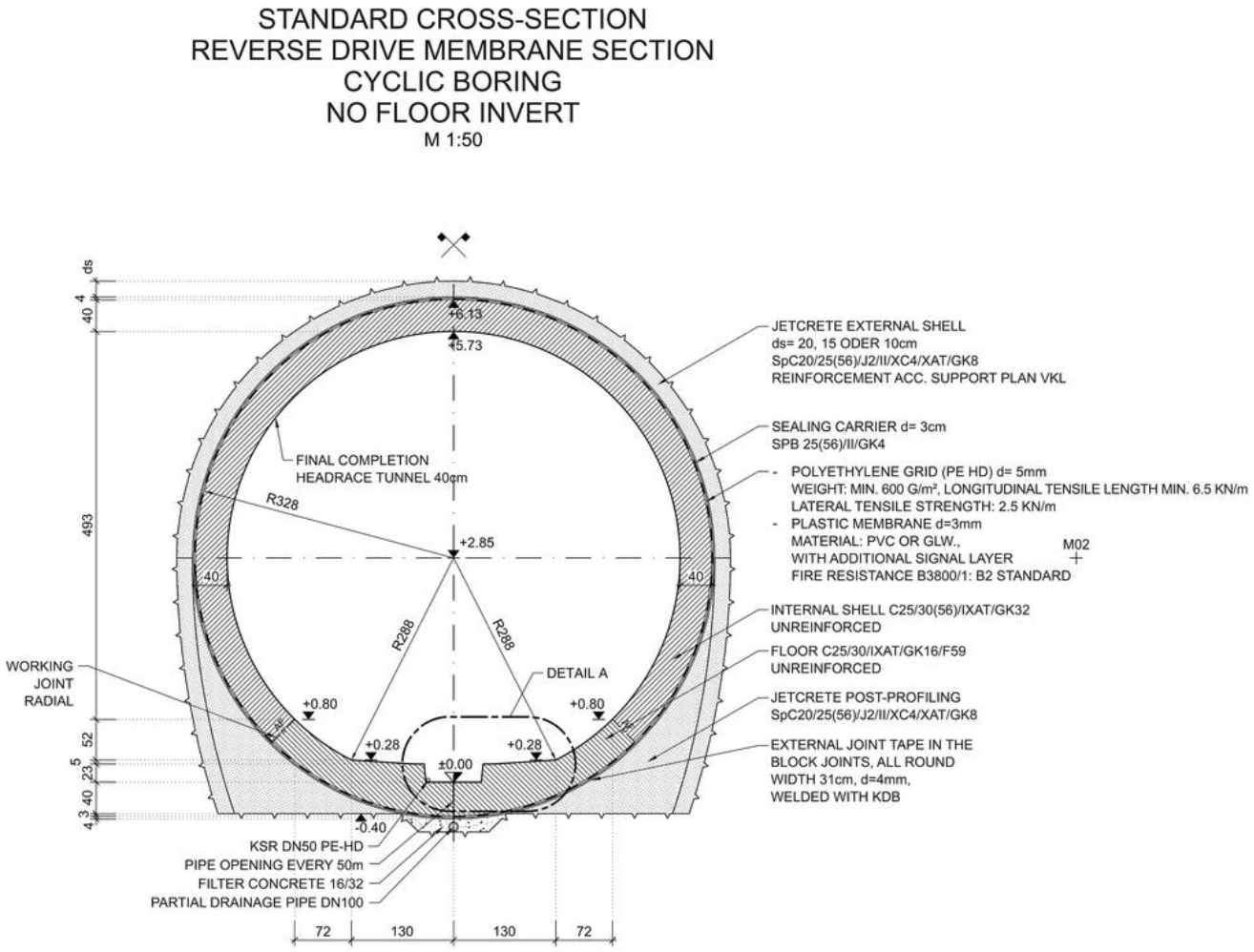
Tricky tunnel advance

The underground construction work for the 380m long inclined shaft proved particularly challenging. The shaft, which has an incline of 31% and cross section of 23m², was driven upwards from below. The steep inclination meant the wheels were pushing their logistical limits, and a mixed system with caterpillar tracks and tyres was put in place. In order to meet the specified deadlines, the tunnel boring work was given priority, beginning at the end of February 2015. Excavation of the inclined tunnel was complete after a mere four-month construction period, with no significant problems.

The intake tunnel for the valve chamber is 290m long, with a profile of 47m². Work began in April 2015. In order to keep on schedule, parallel work started in June 2015: boring the 65m-long upper chamber bore and excavation of the 22m-long shaft head.

While the access tunnel was being bored close to the surface, there were numerous blast restrictions in place for protection of the local residents. This meant that at first, work could only be carried out during the daytime on workdays. Only once the boring had progressed to a pre-specified stage were additional shifts introduced. In September 2015, work began on boring the 1,000m-long headrace tunnel, which has an excavated cross-section of 43m². A conventional drill and blast process was used to bore the tunnel as far as the dismantling chamber. This was primarily due to the small curve radius – 500m – and the need for the tunnel to be sealed in the phyllite section.

In parallel with the tunnel boring, the surge shaft was erected in two phases. The first phase was the construction of a spoil shaft with excavation diameter of 1.84m, using the raise boring procedure – this involved boring a circular shaft around a pilot bore. A drilling & blasting phase then developed the cross section to its final 15.38m diameter.



Standard tunnel cross-section for the cyclic boring. Source: GKI GmbH

Extensive finishing work

Before cladding the headrace, the rock was consolidated with injections. In this way, the consortium was able to reduce permeability and make the stone more homogenous. In addition, compensation was made for the almost hollow stone loosened during the conventional drill and blast process, so that the original mechanical characteristics were restored. The injections were carried out in two phases, referred to as the primary and consolidation injections.

An unreinforced in-situ concrete inner shell was used to clad the headrace tunnel as far as the cone. This was sealed all around over the first 774m from the valve chamber. The remaining 230m to the dismantling chamber have not been sealed. A shotcrete interstice was built into the floor of the reverse drive bore inner shell, before the seal was installed. The aim was to end up with a virtually circular profile, since the high water pressure and potential swelling pressure would not allow for any significant deviations from the circular shape. Once the shotcrete interstice was in place, IAT GmbH installed the sealing membrane in the floor. A lime separating coat was applied in the unsealed region. In order to make the ground suitable for traffic again, the unreinforced invert concrete was installed blockwise overhead from the valve chamber in the direction of the dismantling chamber. In parallel with the concrete work, the vault was sealed during night shifts. Once the compressive strength measures described above were complete, the finished inner shell was pre-tensioned with joint injections and the pre-tensioning effects then tested using laser scanner measurements and real-time evaluation of the results.

The sealing work was carried out in parallel with the concrete production, during night shifts. Source: GKI PRB consortium

An armoured design was used for the transition between the headrace tunnel entrance and the cone. Concrete backfill was put in behind the steel plating in the area around the inclined shaft. Despite the relatively low inclination in the shaft, the concrete backfill installed via a channel, which meant that an appropriate concrete recipe was required. Concrete supplier TB Zams carried out a large-scale test of various different recipes. This was done in the concrete factory by filling a formwork with built-in obstacles via 31%-inclined channel, matching the original, so that the flow behaviour of the concrete could be assessed. The concrete backfill work was carried out in close consultation with the third-party contractor for the hydraulic steel structures. Once the armour plating was complete, the joint injections for the construction lot were installed in both the ridge and the shrinkage gap between the reinforcement and the concrete.

In the TB Stams concrete factory, a large-scale test was carried out to find a suitable concrete recipe for the concrete backfill. Source: GKI PRB consortium

The plumb shaft was clad with a reinforced, 50cm-thick concrete inner shell, sealed externally. As before, the stone was injected before sealing, and then once the inner shell was complete, a pre-tensioning injection was carried out. The inner shell was manufactured using slipform casting. The platform set-up for the poured concrete was used several times before and after the actual slipform casting as a working platform for all work being done in the shaft.

The working platform for the poured concrete was subsequently used as a platform for all the shaft work. Source: GKI PRB consortium

The tunnel boring work in the inclined shaft was given priority, so that the schedule could be met. Source: GKI PRB consortium

Underwater work for the powerhouse

The powerhouse consists of a largely underground powerhouse shaft constructed from reinforced concrete, which plunges to a depth of 15.60m – 12.50m of this are beneath the water table. The shaft construction is surrounded by a 20m-deep diaphragm wall.

The construction pit itself was divided into three sectors; two of these have been sealed with deep-lying soft silicate gel base, while the third is sealed with a 1.20m-thick anchored slab of underwater concrete. The diaphragm wall incorporates the main structure 5m beneath the base of the construction pit and is maintained with a stranded anchor horizon. The silicate gel was installed via piped bores in a 1.95m grid in the soil.

Once the lance had been installed, first the 0.30m thick cover plate and then the entire 2.0m thick gel region were grouted in stages. The main construction area was excavated to the base of the underwater concrete slab using a dredging process. The support anchors for the base slab were installed in a 2.2m grid in the subsoil using a pile driver and piles. Once the anchors were complete, specialist divers vacuumed the fine sand around the base and placed heads on the anchors. The 1,200m³ of underwater concrete was installed via a contractor using the Hop-Dobber process.

This is a floating system consisting of a steel tremie with a collar at the lower end. The floating effect is created by a hollow body around the tremie. The construction pit was kept stable during the lancing process with a dense monitoring system. The quantity of residual water in the total 1,700m² base area was only 4.5l/s. The structural base plate was set on the underwater concrete slab, and then the blocks of the eight powerhouse levels on top of this.

TO PROTECT THE LOCAL RESIDENTS, INITIALLY THE ACCESS TUNNEL WAS ONLY BORED DURING THE DAYTIME.

Robert Wachter, Hinteregger
P&L responsibility major projects

Technical data

150.000m³
Excavation

1.500m
Tunnel length

Diaphragm wall	10.500m²
Surge shaft	100m
Inclined shaft length	380m / 31% incline

Handover on schedule

Work for the Prutz construction lot began in July 2014. The boring work was completed with the last section of reverse drive in April 2018. In August 2018, following a successful pressure test, the finishing work for the reverse drive was completed. In October 2018, the structure was handed over to the client, GKI.

PROGRESS: 100% - COMPLETED
CZECH REPUBLIC/SEDLEC UND PRČICE/2017-18

RENOVATION OF A HISTORIC BRIDGE

Sedlec-Prčice bridge

Author: Alexandr Herzán

PORR renovated an almost 300-year-old bridge between the municipalities of Sedlec and Prčice under the strict supervision of the Czech Monument Care Department.

As the bridge needed to remain open to pedestrians for the duration of the works, PORR also erected an additional aluminium structure. In the course of this project, PORR demonstrated its expertise in the renovation of heritage-protected structures.

Project data

Employer	Středočeský kraj
Contractor	PORR, a.s.
Architect	PONTEX s.r.o.
Order type	General contractor
Project type	Civil engineering/infrastructure . Bridge construction
Project scope	Renovation of a historic stone bridge in a municipal area
Order volume	28 million Czech Koruna (1.1 million euros)
Construction start	04/2017
Construction end	05/2018

Background

In 2016, Středočeský kraj - the Central Bohemian Region of the Czech Republic - invited tenders for a project to renovate the historic bridge connecting the hamlets of Sedlec and Prčice. The structure, originally constructed between 1815 and 1822, comprises three natural stone arches in Empire style and features two sandstone sculptures of the celebrated Czech sculptor Ignaz Platzer Jr. PORR won through with an offer of CZK 28 million, with the contest decided by the lowest viable tender. Winning the contract was also a matter of prestige for PORR, as it represented a reference project for the renovation of heritage-protected structures. The aim of the extensive renovation work was to extend the bridge's lifespan and enhance its load-bearing capacity.

Challenging requirements

Since the last comprehensive renovation in the 1950s, the bridge had been neglected and not sufficiently maintained. Its technical condition was similarly poor. Examinations of the bridge's structure by the client showed considerable road damage, crumbling reinforced concrete rails and significant water ingress into the bridge's structure. It also became apparent that low-quality stone from the surrounding region had been used in its construction. The identified defects had negative implications both for the bridge's lifespan and its load-bearing capacity.

PORR was able to extend its lifespan by replacing the bridge equipment. The road surface and, above all, the ageing reinforced concrete rails were replaced and fully functional bridge draining systems were installed. This work involved installing new parapets, bituminous waterproofing and new composite panels, while the natural stone masonry was also

renewed in places. All work was carried out under the supervision of the Czech Monument Care Department and subject to the condition that the bridge remain open to pedestrians for the duration of the renovation work. To this end, a lightweight aluminium bridge structure was erected to allow pedestrians to traverse the construction site and the Sedlecký potok stream.

Caption: A new road surface was applied on the bridge and its ageing concrete rails were replaced. Source: PORR

Caption: The bridge with its statues of celebrated Czech sculptor Ignaz Platzer Jr. Source: PORR

Elaborate surface treatments

The first construction phase saw the bridge surface removed. The carriageway surface was broken up and the pavements and kerbs were dismantled. Work then took place to renovate the concrete upper faces of the arches with a new surface drainage system between the revetments and parapet walls. A reinforced concrete slab of concrete quality C30/37 XF3 was laid over the revetments and between the retaining walls. To prevent deterioration, the surface of the right-hand wall – smoothed out with mortar and concrete – was coated with a layer of expanded polystyrene. On the left-hand side of the wall, supports were inserted for the end profiles as the Monument Care Department specified that the existing stonework was not to be dismantled. PORR fulfilled this technical requirement by erecting scaffolding to support the arches along the full length of the bridge.The bridge's composite panel was

realised with a roof-shaped transverse gradient of 2.5% and in varying thickness: 341mm at the centre line of the bridge, 250mm in the channel area and 200mm in the end areas. Beneath the bridge's composite panel, a 15cm-thick bottom concrete layer was applied on top of the compacted frost-proof fill. On top of the bridge's composite panel, the bituminous-sheeting moisture proofing was applied on top of a sealing layer. The drainage of the bridge's composite panel uses a drainage channel and a pipe system connected to the kerb drainage system's collecting pipe. The edges of the reinforced concrete panel were fitted with reinforced concrete covers anchored directly in the bridge's carriageway slab. The carriageway slab and the covers feature expansion joints and elastic shrink joints every 15m.

INSPECTIONS SHOWED ROAD DAMAGE, CRUMBLING REINFORCED CONCRETE RAILS AND HEAVY WATER INGRESS INTO THE BRIDGE'S STRUCTURE.

Alexandr Herzán
Project Manager, PORR a.s.

Technical data

2.042,25m²
Area of the load-bearing structure

Total bridge length	194,50m
Bridge height	4,20m
Bridge width	10,90m
Volume of new concrete structures	1.200m³

The watchful eyes of the Monument Care Department

Following installation of the sealing system, kerb drainage points were installed at 10m intervals; like the granite waterspouts, they had to be approved by the Monument Care Department. The same applied to the reinforced concrete rails erected on top of the reinforced covers. A prototype was presented to the Monument Care Department to demonstrate the steel rod interiors. PORR realised a three-layer asphalt carriageway between the kerbs. The pavements feature natural stone paving in a sand bed, with a transverse gradient of 2.5%.

Caption: Even the kerb drainage systems needed to correspond to the specifications set down by the Monument Care Department.
Source: PORR

After approval

Once work to install the road surface had been completed and the bridge recommissioned, the arch-supporting scaffolding was dismantled and the arch structures and supporting walls treated with high-pressure water-jet cleaning. The water pressure of 1,200 bar was tested in advance on reference surfaces. In the course of this work and further necessary examinations, cavities were identified in the arches and subsequently filled in using a mortar injection procedure. The natural stone masonry was grouted to a depth of 80mm. The jointing - once again in coordination with specialist heritage officers - was carried out using lime mortar with max. 5% white cement additive for stones made of soft and porous rock and max. 10% for those made of igneous rock. The visible areas of jointing were neither mechanically smoothed nor treated in any other way. Instead, the mortar was coloured with sand to match the natural tone of historic mortar. Any missing or weathered parts of the natural stone masonry were repaired using the resulting rubble, while ensuring the joint distribution remained even.

The visible areas of jointing were neither smoothed nor treated in any other way. Missing parts of the natural stone masonry were filled in using rubble. Source: PORR

New paving

The final part of the restoration work involved replacing the paving on the floodplain and the paving beneath the bridge. The base of the bridge was also consolidated to prevent the parts of the arches that had been filled in and the abutments from being worn away by standard water flows. Some 3m of paving was laid upstream of the bridge as well as 3m downstream and in the entire riverbed beneath the bridge. The entire area covered by the stream during flooding was also cleaned up. Concrete sleepers were used to pave the riverbed.

The bridge's foundation is made up of natural stone masonry. Source: PORR

IN PROGRESS
GERMANY/NEUENTAL-BISCHHAUSEN/2017-19

EXTENDING OVER THE VALLEY

BAB 49 BW 103 Goldbachtal Bridge

Author: Uwe Fey

In June 2017, Hessen Mobil Strassen- und Verkehrsmanagement Kassel awarded PORR the construction contract for the new Goldbachtal Bridge.

Using a precise cost estimation which took PORR's complete value chain into account, we were able to offer the best price for the complete contract. In order to ensure optimal project execution, the construction aids were developed and built from scratch.

Project data

Employer	Hessen Mobil Straßen- und Verkehrsmanagement Kassel
Contractor	PORR Deutschland GmbH
Architect	Leonhardt, Andrä und Partner, Dresden
Order type	Main contractor
Project type	Civil Engineering/Infrastructure . Bridge construction
Project scope	Construction of a bridge 285 m long, using composite construction
Order volume	20.45 million euros
Construction start	07/2017
Construction end	10/2019

Background

In 2017, Hessen's Road and Transport ministry in Kassel (Hessen Mobil Strassen- und Verkehrsmanagement Kassel) appointed PORR as the main contractor for construction of the 285 m long Goldbachtal Bridge, which forms a component of the new section of the A49 national motorway. The contract covers setting up the construction site, earthworks and foundation work for the bridge columns, and the abutment embankments. It also incorporates manufacturing the superstructure as a composite cross-section with steel box girder and reinforced concrete slab carriageway, and constructing a concrete trough for drainage. Finally, the passive concrete and steel protection system for the parapets and the establishment of noise barriers around the abutments also form part of the contract. PORR was able to offer the best price for the complete contract by taking the company's complete value chain into account. PORR Deutschland GmbH's Steel Construction and Civil Engineering departments were involved in the special civil engineering cost estimations, along with PORR subsidiary Stump. The Steel Construction and Infrastructure departments at PORR Deutschland are also working closely together during project implementation.n.

SEVERAL CONSTRUCTION AIDS WERE PLANNED AND DEVELOPED DURING THE PROJECT.

Uwe Fey
Project Manager, PORR Deutschland

The columns have a height of just 30 m. Source: PORR

Extensive preparations

As soon as the contract had been awarded, planning work began on the electricity supply to the construction site, site facilities and access roads. The client had made available their verified structural analyses and object planning, including the material distribution plan for the steel superstructure, meaning that PORR was also able to make an immediate start on execution planning and designs for the steel construction, substructures and construction aids. The decision was made to design and build our own components for the incremental launch procedure. These include the launch rockers used on the abutments and columns, and in the prefabrication area. We also created a launching nose for launching the steel base, plus the launching system itself, which includes a lateral slide strand jack of our own design. These will eventually become part of the PORR inventory, enabling us to deepen our value chain for future similar construction schemes by using our own equipment.

Components including the launch rockers, a launching nose for shifting the individual sections and a launch system including a lateral slide strand jack of our own design were developed from scratch and can now be used for other projects. Source: PORR

The bridge takes shape

As soon as the preliminary work was complete, the Special Civil Engineering department began work manufacturing the bored piles along the lines where the columns would emerge. Although the drilling team had to battle through unusually hard rock, the special civil engineering works were completed on time in May 2018. Meanwhile, work on the columns had begun in parallel with the bored piles in March 2018. The columns were manufactured using a climbing formwork with climbing section lengths of 5 m, then reinforced and concreted. The exposed formwork was created using a board structure with a rough-sawn surface.

March 2018 also saw the start of work on the 160 m long and 30 m wide prefabrication area where the steel structure was assembled. At the same time, the embankment for the abutments was being constructed. The foundation for the abutment was integrated into the embankment. It is founded on the load-bearing colluvial deposit and made from unreinforced concrete. This foundation was built in during construction of the embankment as underfill for the abutment foundation. Around 3,000 m³ of concrete was built into each abutment for this purpose.

Around 25,000 m³ of earth had to be excavated for the

prefabrication area, and stored to one side for later replacement. Source: PORR

Complex steel work with our own construction aids

In the middle of April 2018, the time came to set in place the eleven prefabricated steel components for launch cycle 1 of the first section of the eastern superstructure. Delivery of the steel components, weighing up to 85 t and measuring 35 m in length, represented an enormous logistic challenge for this process.

PORR began work on manufacturing the abutments in May 2018. Before this, however, the embankment had to be raised to the lower edge of the abutment, a cubage of around 20,000 m³. Once this was done, the abutment was shuttered to a height of a bit more than 10 m, then reinforced and concreted, so that it could be completed “just in time” for the first launch.Work on the first eastern section was carried out from the middle of April until July: it was welded and checked on the construction site, then shifted out of the prefabrication area – this made room for the second section of the eastern superstructure, which followed immediately. The first launch section was preceded by six weeks of metalwork and welding, sonic and x-ray weld seam checking, and corrosion protection work.

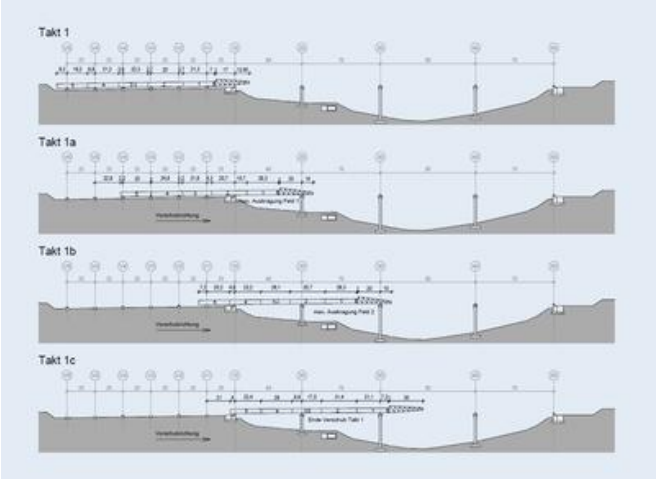
The new construction aids – launch rockers, launching nose and launch system using strand jacks – were used for the first time during this preliminary work.

Six weeks of metalwork and welding preceded the successful launch. Source: PORR

Complex steel work with our own construction aids

In the middle of April 2018, the time came to set in place the eleven prefabricated steel components for launch cycle 1 of the first section of the eastern superstructure. Delivery of the steel components, weighing up to 85 t and measuring 35 m in length, represented an enormous logistic challenge for this process.

The steel components for the second section of the superstructure were unloaded in the middle of July, following the successful first launch section; these were then assembled and launching continued until September. Due to the height of the launch rockers, the eastern superstructure was launched into a position elevated by around 30 cm. Once the launch was complete, the structure was lowered to its final position, and the prefabrication area was converted ready for work to begin on the western superstructure.



Extract from a launch cycle plan. Source: Leonhardt, Andrä und Partner

Technical data

80,000 m³approx.
Excavation volume

19.100m³
Concrete incorporated

Construction pit depths	Up to 12m
Bridge lengths	2x 285m
Tarmac	1260t poured asphalt MA
Drill piles	D 1500mm, L up to 18.50m
Steel incorporated	2.700t
Reinforced concrete	2.200t

Looking ahead

The abutments and columns have now been completed. The steel components for the western superstructure have been shifted already or are on-site ready for assembly. The

formwork carriage for creating the carriageway slabs has been assembled; production of the slabs began in December 2018 using a back-and-forth process where the carriageway slab in the centre of the bridge area is concreted first of all, followed by the slabs above the columns.

Manufacture of the parapets will start in spring 2019, using PORR's own parapet formwork carriage, specially designed in 2018 for the Rothof Valley and Goldbachtal bridges. Corrosion protection work on the inside and outside of the steel box girder will likewise take place. In summer 2019, the cladding work will be carried out and the superstructure kitted out.

Completion of the Goldbachtal bridge is scheduled for autumn 2019. Source: PORR

COMPLETED
AUSTRIA/2018

REHABILITATION OF THE ARLBERG RAILWAY'S HIGHEST VIADUCT

Schmiedtobel viaduct

Author: Florian Sterner, Stefan Plankensteiner

PORR rehabilitated the Arlberg railway's 130-year-old Schmiedtobel viaduct under extreme time pressure and highly cramped conditions.

In addition to reinforcing and widening the load-bearing frame, the rehabilitation of the viaduct also comprised the restoration of 4,000m² of masonry and the construction of a 450m-long access road. The frame had to be rehabilitated within just two weeks.

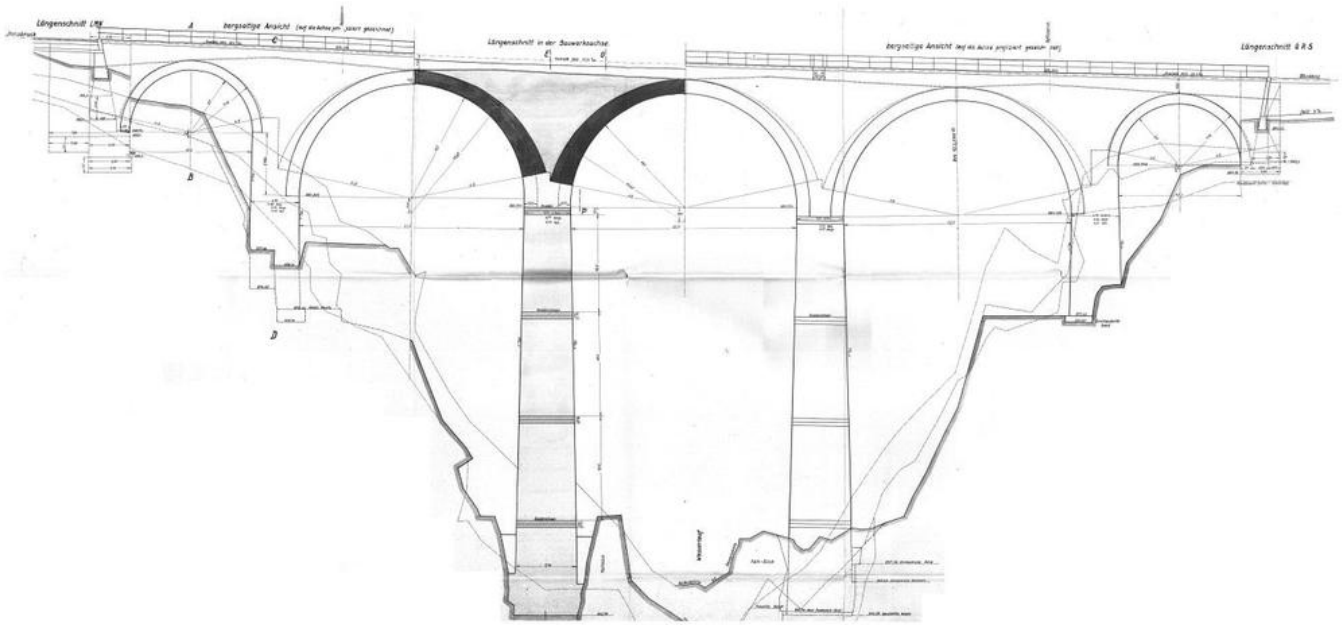
Project data

Employer	ÖBB Infrastruktur AG
Contractor	PORR Bau GmbH . Tyrol branch
Order type	Master building services
Project type	Civil engineering/infrastructure . Bridge construction
Project scope	Structural reinforcement and widening of a 130m-long railway viaduct, rehabilitation of 4,000m² of natural stone masonry and construction of a 450m-long access road
Order volume	2,6 million euros
Construction start	03/2018
Construction end	10/2018

Background

Built between 1880 and 1884 as an intrepid mountain railway line, the Arlberg railway connects Tyrol with Vorarlberg. The 19 viaducts in particular are impressive examples of engineering structures of the time. The highest and, on the Vorarlberg side, longest viaduct is the Schmiedtobel viaduct between the Dalaas and Hintergasse railway stations. This bridge structure is 130m long and spans the rocky Schmiedtobel ravine. The tallest pier has a height of approximately 50m. Due to the increase in rail traffic, ÖBB Infrastruktur AG decided to carry out a general rehabilitation of the 130-year-old structure to improve drainage and overall structural stability.

The Tyrol branch of PORR Bau GmbH secured the contract for resurfacing the railway tracks and rehabilitating the Schmiedtobel viaduct. The works all had to be carried out between March and October 2018. Since the Arlberg railway is critical for rail traffic within Austria and throughout Europe, the actual frame had to rehabilitated within a strict two-week track closure period.



As-built drawing of the “Viaduct across the Schmied-Tobel” built in 1883 Source: ÖBB

TO REACH THE CONSTRUCTION SITE, WE HAD TO CLEAR, RESURFACE AND EXTEND AN APPROXIMATELY 550M-LONG FORESTRY TRAIL.

Florian Sterner
Site manager, PORR Bau GmbH

Extensive preparatory works in difficult terrain

Since the building site was only accessible by rail or on foot, the first step was to build a construction site access road. An approximately 550m long forestry trail had to be cleared, resurfaced and extended up to a plateau south of the railway on the east side of the viaduct. A storage compound and turning area was built at the end of the access road. Both the forestry trail and the compound will be made available for conservation measures after the rehabilitation of the ÖBB Schmiedtobel viaduct.

The Schmiedtobel viaduct before the start of construction Source: PORR

For reasons of construction logistics, the prefabricated edge-beam parts were produced as early as March 2018, transported by rail during a short interim track closure period, and stored on the west side of the viaduct prior to installation. As the renovation work on the vault and viaduct masonry could not be carried out within the track closure period, scaffolding was erected around the entire bridge structure from June to July 2018. The extremely steep terrain leading up to the pier bases presented a major challenge for the scaffolders. A supply ropeway was slung across the ravine to transport the scaffolding material, which weighed 320t. A bracket scaffold with a railing was also attached to the existing wall at track level that would subsequently serve as a demolition, work and protection platform.

A total of 320t of material was used for scaffolding the Schmiedtobel viaduct. Source: PORR

A tight time slot for rehabilitating the frame

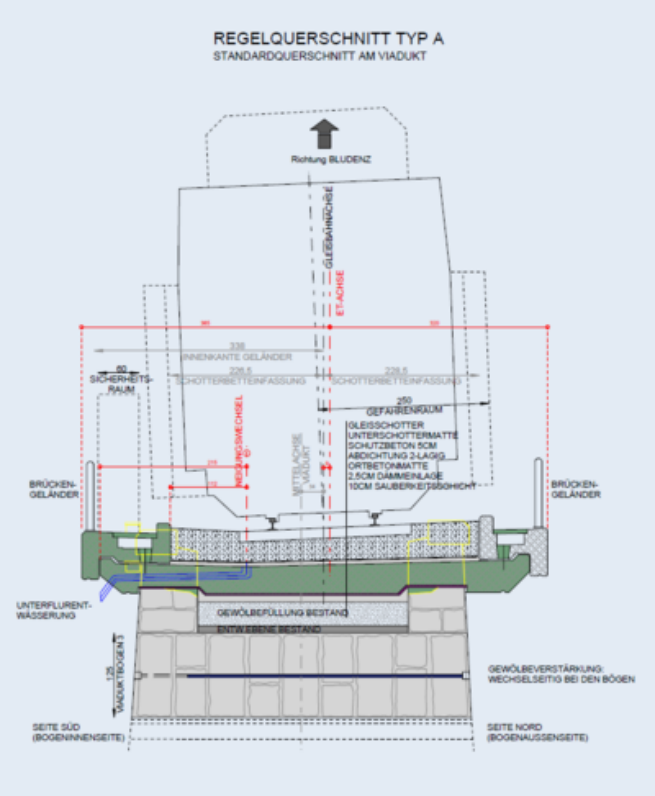
The viaduct consists of three larger arches with a 26.6m span in the middle and two smaller arches on either side, in front of the abutments. The approximately 4.5-metre-wide vaulted arches have been bricked up with roughly 80cm-thick side walls. Previously, the gap had been filled with bulk material and, in some places, tamped concrete. A drainage level runs through the roof profiles along the viaduct. The water is drained from the lowest point at the centre of each arch.

WE COMPLETED THE STRUCTURAL RESTORATION WITHIN ONLY TWO WEEKS.

Florian Sterner
Site manager, PORR Bau GmbH

Using a rope crane to scaffold the pier. Source: PORR

After ÖBB had completed preliminary works, including removing the overhead line and dismantling the track grid, PORR was able to begin renovating the supporting frame. The first step involved cutting the vault walls horizontally to align with the bottom level of the new frame. This was followed by removing the railing including the cable duct, clearing the track ballast, and dismantling the side walls and the vault filling.



Standard cross section of the reinforcements Source: ÖBB

After creating the blinding layer on the vault filling and laying the 2.5cm-thick elastomeric bearings, the team was able to begin work on the frame. For this purpose, the viaduct was reinforced with a 45cm-thick in-situ concrete slab widened to 6.3m in five construction stages. The necessary formwork, reinforcement works and concreting were carried out at staggered three-day intervals. After that, a new two-layer seal was applied for bridge drainage and the prefabricated edge beams with integrated cable ducts were installed. After the protective concrete layer had been applied, the sub-ballast mats laid and other finishing works completed, the ballast was laid on the track ballast bed to finalise the resurfacing works. Finally, the tracks were laid and the overhead line restored.

The entire frame had to be rehabilitated within a two-week track closure period in August. Source: PORR

The entire frame had to be rehabilitated within a two-week track closure period in August. The extremely tight construction schedule was planned down to the hour and presented enormous logistical and technical challenges for PORR's site employees. Nevertheless, the Arlberg railway was reopened to traffic on 3 September 2018 as planned.

Technical data

330m³
Frame slab (in-situ concrete)

Bridge lengths	130m
Bridge deck area	890m²
Natural stone masonry removed	170m³
Sealing	890m²
Elastomeric bearings	680m²
Protective concrete layer	580m²
Reinforced concrete	50t
Prefabricated edge beam	113 pcs.
Bridge railing	255m
High-pressure water jetting/sand blasting natural stone masonry	4.000m²
Rehab. natural stone masonry	3.000m²
Niro anchors dm 20mm	520m
New access road	450m
Aggregate base course	1.700m³

Rehabilitating the masonry

Before the track could be resurfaced, the PORR specialists

had to reinforce the arch vaulting with 126 transverse prestressing elements. To this end, 20mm-diameter stainless steel rods with rolled threads were pushed into 4m long horizontal drill holes which were then filled with cement mortar. Then, all the masonry surfaces were cleaned with high-pressure water jets. Any damaged joint mortars were scraped out by hand and replaced with dry jetcrete for friction-locked closure. To finish off the rehabilitation, the masonry was treated with a sandblasting machine to create a uniform surface.

Conclusions

In this project, PORR was able to impressively demonstrate its experience and competence in infrastructure and bridge construction. The greatest challenges to rehabilitating the Schmiedtobel viaduct were the very cramped conditions, the topographical location of the construction site in a ravine and the extremely brief construction period allowed for rehabilitating the frame. Thanks to the excellent cooperation between everyone involved in the project, the works were all completed on schedule in October 2018.

The project was handed over to the employer in October 2018. Source: ÖBB

PROGRESS: 100% - COMPLETED
AUSTRIA/PIRKA/2017-17

PROCESSING CONSTRUCTION MATERIALS FOR HIGH-QUALITY RECYCLED PRODUCTS

Pirka recycling plant

Author: Jürgen Stocker, Julia Schimek

PORR Umwelttechnik has set up a stationary building material recycling plant in Pirka to promote recycling management and sustainability.

By establishing this plant, PORR Umwelttechnik GmbH is taking a future-oriented step towards achieving sustainability. A wide range of recycling materials in product quality can be produced at the plant.

Project data

Contractor	PORR Umwelttechnik GmbH
Project type	Environmental engineering
Project scope	Construction of a permanent recycling plant and the renovation and integration of an existing gravel and crushed stone processing plant
Construction start	06/2017
Construction end	12/2017

Background

The use of recycled building materials within a sustainable construction process is becoming increasingly important in the construction industry, and quality requirements are constantly growing. PORR Umwelttechnik is keeping up with this trend and, after six months of work, has completed the construction of a modern recycling plant in the municipality of Seiersberg-Pirka, south of Graz, Austria. The new plant will enable the production of a wide range of product-quality recycled materials.

Renovation and extension of an existing plant

An existing gravel and crushed stone processing facility formed the basis for the project. The existing plant was completely overhauled and integrated into the newly constructed recycling plant in the course of two stages of development. The two extensions (first and second plant sections) can be operated either separately or in succession. PORR Umwelttechnik commissioned BAG Klöch Aufbereitungstechnik GmbH to construct the plant. The necessary renovation work to the existing plant was undertaken by the company itself together with PORR Equipment Services GmbH, and all master building work, such as structural engineering, foundations, conduits and power connections, was completed by PORR Bau GmbH. The total costs for the facility amounted to 1.6 million euros.

The Pirka recycling plant was constructed in just six months. Source: Daniel Ulbricht-Sundt

Work to convert the old gravel and crushed stone processing plant began in June 2017. The first extension to the plant includes the feed hopper, jaw crusher, screening unit, impact crusher and various conveyor and stockpile conveyors. As part of the overhaul of the existing plant, new plant components were added, including the magnetic separator, feeder and operating station. The screening unit, impact crusher and jaw crusher were refurbished in collaboration with PORR Equipment Services. As part of the second extension, a further feed hopper, a pre-screening unit, a light material separator, a dewatering screen, a manual sorting system and various stockpile conveyors were installed. The recycling plant is designed for a capacity of up to 150 t/h. Due to the tight construction schedule, all construction work on the plant was completed within six months by December 2017. This enabled PORR Umwelttechnik to establish a treatment process to produce high-quality recycled construction materials as an alternative to primary raw materials. The treatment process consists of two stages, which can also be operated individually.

The recycling process

The construction waste, such as building rubble, delivered to the plant is tipped onto an asphalted temporary storage area. Following a rough pre-sorting or pre-crushing process, a wheel loader is used to transfer the material to be processed either into the feed hopper of the first extension to the plant (first processing stage) or directly into the feed hopper of the second extension (second processing stage) – depending on whether it needs to pass through the entire plant or only sections of the plant.

The light material separator with dewatering screen in the first extension. Source: Daniel Ulbricht-Sundt

WE ARE MAKING A SIGNIFICANT CONTRIBUTION TO IMPROVING SUSTAINABILITY AND CONSERVING NATURAL RESOURCES.

Julia Schimek
Project Manager, PORR Umwelttechnik

First processing stage

From the feed hopper, the mineral construction waste is transported to the pre-screening unit via the feeder. The initial separation of the construction waste takes place here – into fine, medium and coarse fractions. The fine

fraction is stockpiled via a collector conveyor and a slewing conveyor. The medium fraction is transferred to the light material separator via a feeder belt with overbelt magnetic separator. The lightweight materials are collected in skips and disposed of externally if necessary. The fraction cleaned of lightweight materials is dewatered using a dewatering screen and delivered via a further slewing belt, where the fine fraction can be added. The excess water from the light material separator and the dewatering screen is fed into the sand trap area of an infiltration basin at the site, which is operated as a sedimentation tank. The settled solids are regularly pumped out and disposed of using a pump truck. The purified water is recycled and supplied to the light material separator. This minimises the need for fresh water.

The coarse fraction then reaches the picking belt. Contaminants and recyclable materials are removed manually at the manual sorting station. The materials that are removed in this process are stored in containers via disposal chutes and recycled. Iron and pure brick fractions are recycled. Non-recyclable materials are disposed of. A feeder transports the now contaminant-free coarse fraction to the feed hopper of the second extension or, in the case of dual operation, it can also be transported from the sorting cabin to a stockpile.

The light material separator with dewatering screen in the first extension. Source: Daniel Ulbricht-Sundt

THIS RECYCLING PLANT WILL SEPARATE APPROXIMATELY 180,000 TONNES OF CONSTRUCTION WASTE EACH YEAR.

Jürgen Stocker
operations manager - recycling plant

Second processing stage

Following manual sorting, a feeder conveys the material into the hopper. If the second extension is being operated separately, the material is instead delivered via a wheel loader or lorry. The hopper has a capacity of 40 m3 and acts as buffer storage if the material is delivered via wheel loader or lorry. The material is broken down to the desired grain size in the jaw crusher. The crushed material is transferred to a screening unit via an ascending conveyor with a belt scale and overbelt magnetic separator. Product classification takes place here, with the oversize particles fed via an ascending conveyor to a further impact crusher with pre-silo, and broken down to the required size. The screened fractions are held in stockpiles and quality assurance checks are performed. Different fractions can be produced at the new recycling plant and used in construction, contributing to the conservation of natural resources. The plant processes approximately 180,000 t of construction waste each year.

About the completed project

A modern permanent recycling plant was constructed in just a short period of time. Following sorting, wet processing and a crushing and classification process during the two processing stages, high-quality recycled construction materials are created, which are then reused.

Conveyor belts with medium fraction and the end product. Source: Daniel Ulbricht-Sundt

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