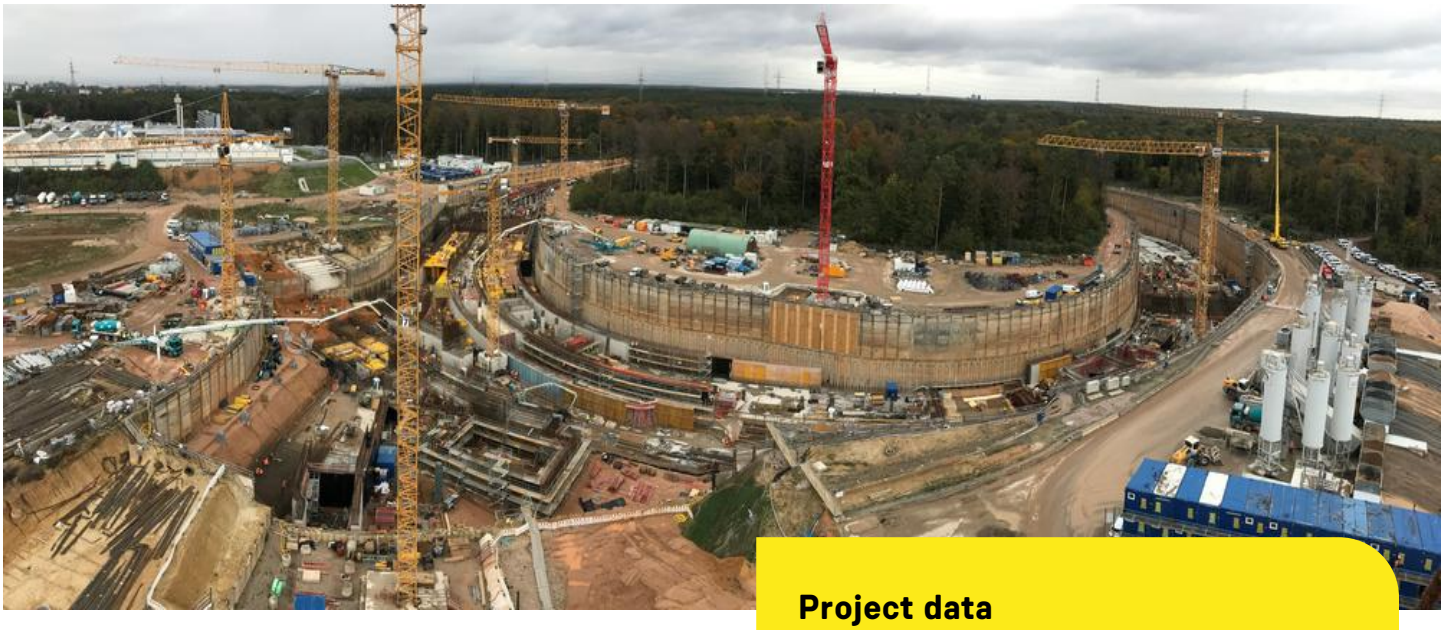


IN PROGRESS
GERMANY

EXTENDED STRUCTURAL WORK FOR FAIR

Facility for Antiproton and Ion Research Darmstadt

Text: Thomas Beckmann

A new particle accelerator is being built in Darmstadt. PORR is responsible for the extended structural work in the north facility area.

The contract includes not only the construction of a 1.1km long accelerator tunnel including the vertical building components, but also a transfer building with an underground transfer hall and the main supply building above.

Project data

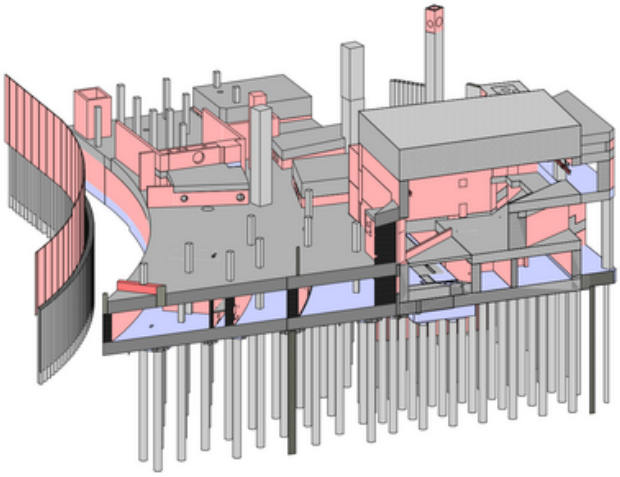
Employer	Facility for Antiproton and Ion Research (FAIR)
Contractor	ARGE FAIR Anlagenbereich Nord, PORR Ingenieurbau und PORR Bau GmbH
Architect	ION42
Order type	Erweiterter Rohbau
Project type	Structural engineering
Project scope	Tunnel and transfer building in a construction pit created on site at a depth of up to 20m.

Background

One of the largest and most complex construction projects in the field of cutting-edge international research is currently underway at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt: FAIR (Facility for Antiproton and Ion Research). A new particle accelerator is to be used to create and research matter inside the confines of the laboratory that is normally only found in the universe. Scientists from all over the world hope to gain new insights into how matter is structured and how the universe has evolved – from the Big Bang to the present day.

The new particle accelerator centre is to be built on a 20ha site by 2025. Source: ion42/FAIR

Several different buildings that are necessary for operating the particle accelerator will be erected on the approximately 20ha site. PORR was awarded the contract for the extended structural work in the north facility area. In order to meet the high requirements, solid reinforced concrete components are being used. The jointless construction method imposes heightened demands on crack limitation and concrete performance.



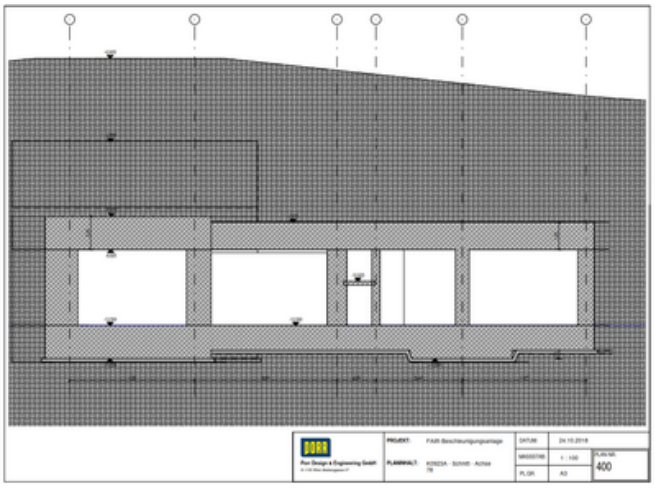
Pile and slab foundation for the transfer building and the tunnel in the transfer hall area. Source: PORR

THE LOGISTICS AND HIGH SAFETY REQUIREMENTS REPRESENT A MAJOR CHALLENGE.

Thomas Beckmann
Project Manager, PORR GmbH & Co. KGaA

Solid structures

Most of the structures are solid reinforced concrete constructions and up to 6m thick. The supporting structures for the buildings are made from solid reinforced concrete with reinforced concrete load-bearing exterior walls, access cores and interior columns, and interior walls in reinforced concrete supporting reinforced concrete floors.



The accelerator tunnel consists of a floor slab up to 2.0m thick, outer walls 1.0m to 2.0m thick, and ceilings up to 2.0m thick. Source: PORR

The accelerator tunnel will have shallow foundations, while the solid transfer building and the tunnel in the adjacent area of the transfer hall will be founded on a combined pile and slab foundation. The solid components and the complex frame place very high demands on the planning and execution of the supporting framework. Wall-type beams are temporarily supported by solid concrete columns until the load-bearing capacity of the entire system is achieved.

The complexity of the frame and the jointless construction resulted in a complicated reinforcement layout with very high reinforcement density of the individual components. Source: PORR

High demands on concrete performance

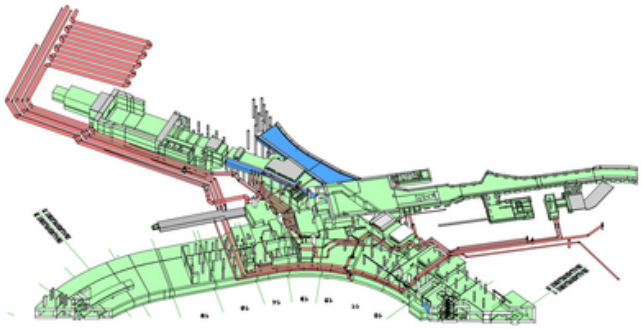
The concrete to be used must have very specific properties. The increased bulk density of 2.35kg/dm³ and the residual water content of 4.5% have led to a formulation that includes basalt aggregate, slow-hardening cement, and high water-cement ratios, placing very high demands on both the workers and the machinery involved in production, transport and processing.

PORR will carry out over 100 large-scale concreting operations averaging 1,500m³ of concrete throughout the duration of the project. Source: PORR

UP TO 250 LORRY JOURNEYS PER DAY ARE NOT UNCOMMON.

Thomas Beckmann
Project Manager, PORR GmbH & Co. KGaA

The concrete is produced directly on site with a mobile mixing plant to ensure a continuous supply of 150m³ per hour and up to 3,000m³ per day. PORR will handle over 100 large-scale concreting operations with an average of 1,500m³ of concrete each throughout the construction period. The peak monthly output will be 15,000m³ of concrete, which corresponds to 33,000t of aggregates and cement, and 3,600t of reinforcement. Given that the excavation and backfilling of the construction pit are being carried out simultaneously, 250 lorry journeys per day are not uncommon. A fresh concrete composite system is used to seal the exterior components.



The pipeline construction carried out alongside the backfilling work also poses a major logistical challenge (pictured: the pipeline construction in the transfer area). Source: PORR

The pipeline construction is also adapted to reflect the dimensions of the overall project. The installation of 10km of steel and HDPE pipelines with diameters of up to 2.0m, along with 25km of cable conduits, which had to be carried out at the same time as the backfilling work, also posed a major logistical challenge.

Conclusion

The project is currently in full swing. The excellent cooperation with PORR Design & Engineering Berlin, Structural Engineering division, and PORR Design & Engineering Vienna, Work Preparation and Structural Engineering division, has helped the construction crews on site to overcome the enormous challenges posed by this major project.

Technical data

6,000 t
Steel incorporated

315,000 m³
Concrete incorporated

Construction pit depth	down to 20 m
Reinforcing steel	40,000 t
Tunnel length	1,100 m
Sealing	117,500 m²
Backfill and cover fill	900,000 m³
Pipeline construction up to DN 2000	10,000 m
Cable conduits up to DN 160	25,000 m