VCB Cantilever Bracket and VCC Composite Formwork Carriage

VARIOKIT system solutions for composite bridges

Product Brochure – Issue 07/2019

Content

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Important Information

All current safety regulations and guidelines applicable in those countries where our products are used must be observed.

The images shown in this brochure feature construction sites in progress. For this reason, safety and anchor details in particular cannot always be considered conclusive or final. These are subject to the risk assessment carried out by the contractor.

In addition, computer graphics are used which are to be understood as system representations. To ensure a better understanding, these and the detailed illustrations shown have been partially reduced to show certain aspects.

The safety installations which have possibly not been shown in these detailed descriptions must nevertheless still be available. The systems or items shown might not be available in every country.

Safety instructions and load specifications are to be strictly observed at all times. Separate structural calculations are required for any deviations from the standard design data.

The information contained herein is subject to technical changes in the interests of progress. Errors and typographical mistakes reserved.

VARIOKIT system solutions

Cost-effective construction of steel composite bridges

With VARIOKIT core and system components, stationary cantilever brackets and movable composite formwork carriages for steel composite and precast concrete bridges can be systematically and cost-effectively configured. Due to the practical and innovative systems, it is possible to realise individual project solutions on the basis of the VARIOKIT Engineering Construction Kit and adapt them to suit the respective bridge geometry.

The VCB Cantilever Bracket is used for the production of bridge superstructures using steel composite or semi-finished concrete construction methods. It is permanently mounted on the bridge structure and is moved by means of a crane. The main areas of application are usually bridges with lengths up to 200 m, as a mobile solution is often not a cost-effective option here.

The VCC Steel Composite Carriage can be used to construct steel composite bridges with lengths of more than 200 m. The overhead moving formwork solution is pulled using heavy duty rollers which are mounted on supports positioned on the steel structure.

PERI engineers take on the project-specific planning along with the static calculations of the complete solution. All systems and processes are thus optimally coordinated with each other, facilitating on-schedule completion. Providing the overall solution from one source ensures optimised processes during the course of the project.

VCB Cantilever Brackets
Suspended cantilever formwork for constructing the carriageway slab on steel composite and precast concrete bridges

VCC Composite Formwork Carriage
Overhead mobile solution for constructing the carriageway slab on steel composite bridges

VCB system advantages and detailed solutions

The fast, safe and easy-to-use cantilever formwork for composite bridges

VCB Cantilever Brackets are used for concreting carriageway slabs of composite bridges. The system guarantees cost-effective, safe and efficient work operations for realising short rail, road and motorway bridges, as well as longer, cycle-constructed bridges up to approx. 200 m long.

The system is based on the VARIOKIT Engineering Construction Kit and can therefore be economically adapted to suit a very wide range of geometries and project requirements thanks to the large number of available core and system components. The welded and bolted VARIOKIT Anchor Bracket can also be flexibly mounted to steel or precast concrete girders depending on the actual load.

The sophisticated anchoring technology of the brackets then ensures a high level of safety and efficiency during the construction process. As a result, all assembly work can be safely carried out from the upper side of the bridge. A high concreting speed is achieved by means of the obstacle and discontinuity-free prestressing steel suspension. This is flush with the top edge of the concrete so that vibrating beams and trowels can be used.

Safe assembly and dismantling
as all work can be carried out from above

Flexibly adaptable
to suit a wide range of bridge geometries and project requirements thanks to VARIOKIT

Efficient working procedures
due to fast and comfortable concreting operations with vibrating beams and trowels without any obstacles and discontinuities

Construction kit solution for the realisation of bridge cantilevers
The steel composite construction method is a combination consisting of steel girders in the tensile area and an in-situ concrete slab in the compression area of the bridge cross-section. The semi-finished concrete construction method is a combination of precast concrete beams and an in-situ concrete slab.

Adaptable to suit project-specific requirements
Based on the VARIOKIT Engineering Construction Kit, the VCB Cantilever Bracket can be flexibly adapted to match individual project requirements and geometries.

Safe and efficient work operations thanks to mounting and dismantling the brackets from the upper side of the bridge. In the process, no elevating work platform or erection scaffolding is necessary.

The welded or bolted VARIOKIT Anchor Bracket can be flexibly positioned on the steel or precast concrete girders depending on the load. The bracket is fixed by means of tie rods and tube nuts.

The anchoring is flush with the upper side of the concrete and allows easy and convenient use of vibrating beams and trowels. This facilitates and accelerates the work enormously.

Project Examples

Waldschlösschen Bridge, Dresden, Germany
Elegant and economical crossing of the Elbe thanks to rentable system components

The name "Waldschlösschen Bridge" has not only been given to the bridge structure itself but also refers to the complete 4.5-km-long traffic route which leads up to it. A range of design aspects were taken into consideration when planning the bridge height and geometry, as well as the need to ensure an unimpeded view of the Dresden city centre. PERI planned and supplied the formwork for the superstructure of the steel composite bridge and won over the construction site team with an easy-to-use and, above all, cost-effective solution.

The Waldschlösschen Bridge has a total length of around 635 m. Two steel arches with a span of 148 m reach of a height of almost 26 m above the Elbe and carry the central part of the bridge. They carry the middle part of the bridge. The foreshore bridges account for a large part of the structure's length with double V-shaped piers in place to support the superstructure.

The standard cross-section of the bridge in the arched area has an overall width of approx. 28 m. A 14-m-wide, 4-lane carriageway runs between the two steel arches whilst 4.45-m-wide pedestrian and cycle lanes cantilever outwards on both sides of the bridge respectively.

The customised formwork solution for the superstructure was developed by PERI engineers on the basis of the VARIOKIT Engineering Construction Kit. With the standardised, rentable system components and construction-compliant connecting means taken from the modular construction kit, the superstructure could be cost-effectively realised and optimally adapted to suit the project requirements. Essential system components for the raised formwork units suspended on the steel structure were SRU Steel Walers and SLS Heavy-Duty Spindles. The mounting points for the formwork units were planned before the production of the

The carriageway of the steel composite bridge was constructed using 21 concreting sections. The raised formwork units were based on rentable system components taken from the VARIOKIT Engineering Construction Kit.

In spite of the geometric changes found in the superstructure, only two standard raised formwork units were used which resulted in a very high degree of material utilisation.

The project-specific solution with lightweight raised formwork units ensured fast and simple moving to the next concreting section with the crane.

steel structure. The proven, very high load-bearing and rigid wooden GT 24 Lattice Girders transferred the loads into the formwork units and allowed large spans with only a minimum of deflection. All system components used for the frame construction units were rentable which made the project-specific solution extremely cost-effective.

In order to minimise deformations, a total of 21 casting segments were planned for the carriageway slab and cantilevers. In spite of the geometric changes found in the bridge construction, forming could be carried out using only two standard raised formwork units: the length of the units was planned so that they could be easily combined in a number of ways for the construction of the sections. The raised formwork units mounted on-site were thus used for almost the entire bridge structure.

Due to the multiple use of the raised formwork units and the use of the VARIOKIT modular construction system, building operations progressed from one concreting section to the next without requiring any modification work. The formwork units were also relatively light which meant they could be quickly and easily moved and handled. Thanks to the simple and user-friendly design, the construction team could familiarise itself very quickly with the operating sequences. The high degree of material utilisation along with the simple application made the formwork solution very cost efficient.

Project examples

Svevia Bridge, Stockholm, Sweden

Blaichach Bridge, Germany

Renkertobel Bridge, Riedberg Pass, Germany

Koralmbahn ÖBB, St. Paul, Austria

VCC system advantages and detailed solutions

The flexible and load-optimised composite formwork carriage

The VCC Composite Formwork Carriage is used for incremental concreting operations for realising carriageway slabs on longer steel composite bridges. This overhead formwork solution is used for steel composite bridges with lengths of more than 200 m.

The system is based on the VARIOKIT Engineering Construction Kit and can therefore be economically adapted to suit a very wide range of geometries and project requirements, e.g. variable cross-sectional geometries, thanks to the availability of a large number of available core and system components.

The cantilever formwork is divided into three main groups: longitudinal trusses, cross beams and formwork unit complete with an adjustment device. The internal formwork is selected according to the type of bridge cross-section. In the process, a distinction is made between movable slab formwork elements on roller brackets and girder or panel formwork. The working and concreting loads from the bridge cantilever formwork and internal formwork are transferred via the cross-frames on the longitudinal truss. This, in turn, rests on carriage supporting points which are welded to the steel construction.

Special roller bearings are used for the moving procedure which are mounted on temporary steel supports. This facilitates smooth formwork carriage operations in the new concreting section.

Unique and cost-effective project solutions
through PERI engineering, material-optimised planning and rentable components

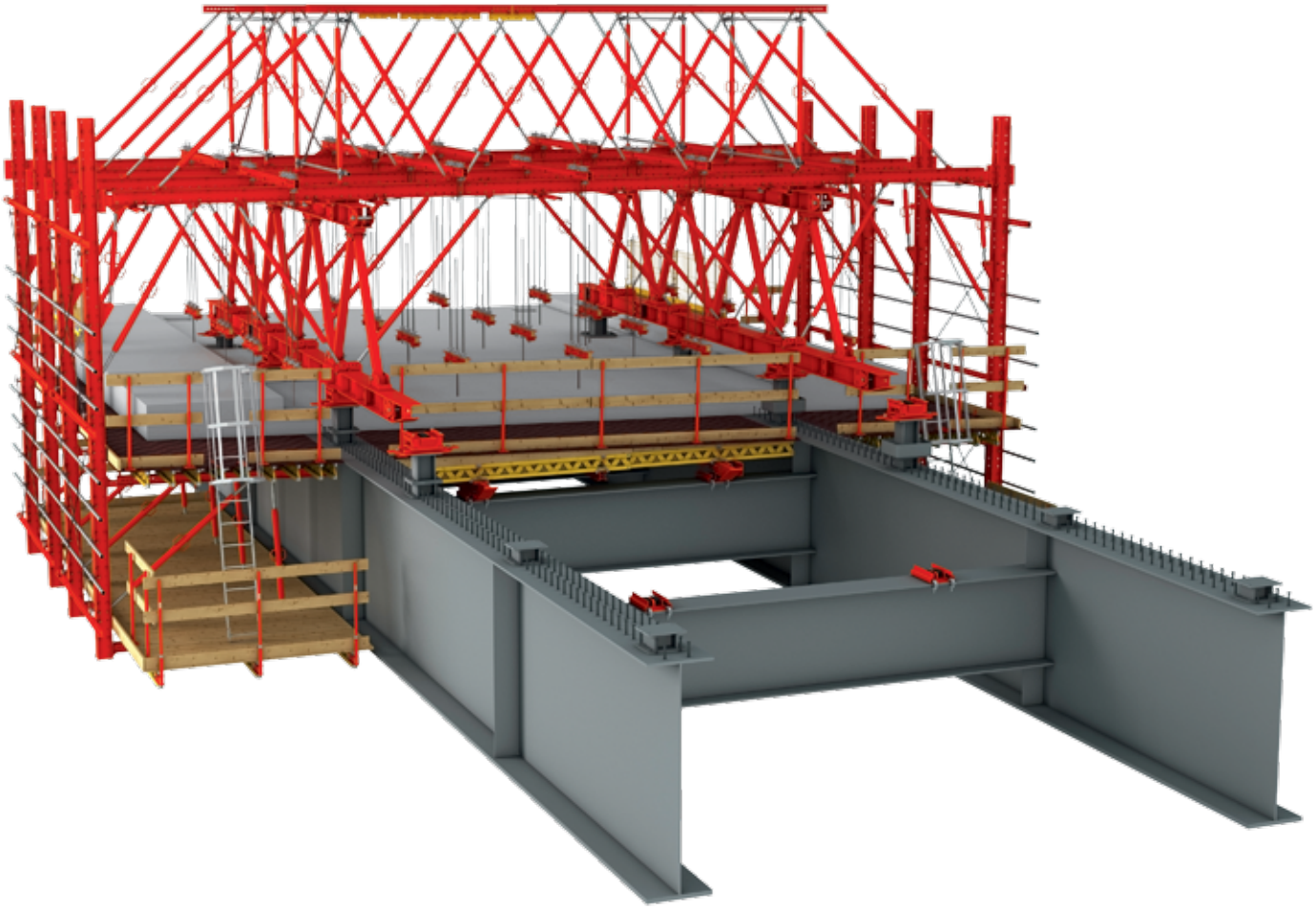
Quickly operational
with standard fitting pin connections and optional delivery of pre-assembled units

Flexible
and easily adaptable to suit a wide range of bridge geometries and project requirements thanks to VARIOKIT

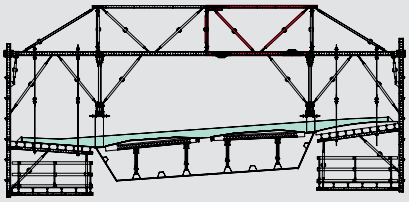
Load transfer takes place via the cross-frames and longitudinal truss on the formwork carriage supports.

The carriage supporting shoe is mounted on the carriage supporting point and facilitates a smooth moving procedure.

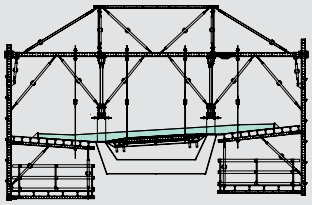
Striking can take place either from the concreting level or the finishing platform.



Quickly operational and mounted through optional pre-assembled units and site-compliant fitting pin connections.



Cross-section 1



Cross-section 2

Thanks to VARIOKIT, the formwork carriage can be modified simply and quickly by removing the components marked in red. This greatly accelerates the construction process involving cross-sectional changes.

Project examples

Lanaye Lock Bridge, Belgium
Individual project solution using a construction kit system

For cost-effective construction of the steel composite bridge, PERI engineers adapted the VARIOKIT system solution – a combination of the VCC Composite Formwork Carriage and VCB Cantilever Brackets – in order to match the specific construction site requirements.

The S-shaped, 15-m-wide bridge structure was realised using the steel composite construction method and featured an unusually large cantilever length of 4.50 m. Formwork solutions based on the VARIOKIT Engineering Construction Kit were used for its construction: the 136-m-long main crossing was constructed with the help of two VCC Composite Formwork Carriages using the alternate sequential method whereby the PERI bridge solution was positioned on radially arranged VCB Cantilever Brackets in the area of the two curve radii.

The steel composite construction method is based on the interaction of steel girders and reinforced concrete. In the first work step, a steel girder was positioned in the form of a box cross-section; then the reinforced concrete slab was formed using two independently operating VCC Formwork Carriages. Consequently, a total of 13 concreting sections with lengths ranging from 8 m to 12 m could be realised within the extremely tight schedule whilst taking into account the required striking times.

The composite formwork carriages were moved using heavy-duty rollers which were mounted on supporting points at a distance of 4 m from the steel structure. The basis formed a longitudinal truss consisting of standardised main beams which were modularly adapted to match the geometric and static boundary

The VARIOKIT Formwork Carriage could be flexibly adapted to match the geometric and static requirements which included 4.50-m cantilevers.

In the complex area featuring the extremely narrow outer radius, the concentrated loads of the radially arranged cantilever brackets were transferred by means of pressure-resistant ties into the existing bridge pier.

The steel composite bridge was constructed using formwork carriages and cantilever brackets taken from the VARIOKIT product range.

The expansion of the Lanaye lock facility required construction of a new 200-m-long road bridge complete with two 90° bends on the river bank areas.

conditions. The lateral formwork unit of the VARIOKIT system could also be flexibly adapted to suit the specified bridge cross-section – this resulted in extremely cost-effective project solutions. In addition, the application on the construction site resulted in efficient and safe working operations: for example, the anchor suspension of the cantilever formwork could be completely operated from above.

On both river bank areas, the bridge structure features two 90° bends – with extremely narrow axis radii of almost 30 m respectively. Here, cantilever bracket units mounted on the steel girders provided an ideal jobsite solution.

Furthermore, the geometric and static complexity in the area of the circular columns was also realised with PERI know-how and the greatest possible use of standard materials. Here, the external brackets were arranged radially whereby the pressure support on the existing reinforced concrete column – by means of VARIOKIT components and MULTIPROP 625 Aluminum Slab Props – was an important part of the project solution.

Formwork units were delivered pre-assembled to the construction site which ensured rapid final assembly and problem-free use. PERI formwork assembly teams in Weissenhorn and Dusseldorf guaranteed accurate assembly and on-time scheduling. In order to achieve the best possible result on the jobsite, technical processing and static calculations were carried out from the start using closely coordinated international teamwork through PERI's Belgian and German engineers.

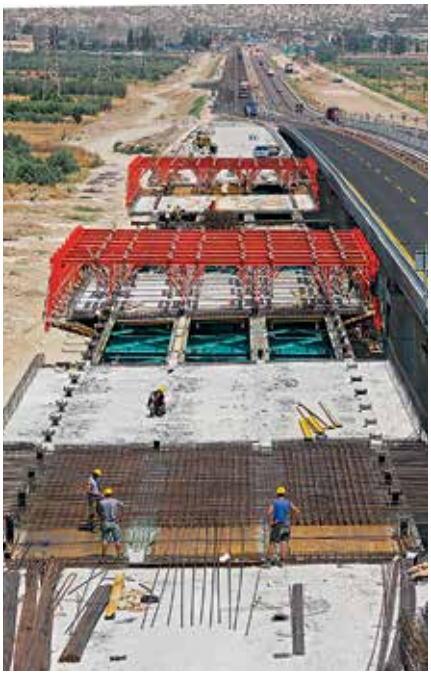
Project examples

Motorway Bridge near Lamia, Greece
Two VARIOKIT Composite Formwork Carriages using the back-step method

The A1 motorway connects the two cities of Athens and Thessaloniki and is considered to be the most important arterial road in Greece. A 840-m-long steel composite bridge was constructed to cross National Highway 3 and a railway line. The two separate, parallel superstructures both feature 22-field spans ranging between 27 m and 45 m.

Using the back-step construction method, the two VARIOKIT Composite Formwork Carriages – each 25 m long and 14.50 m wide – ensured that concreting could take place every second day. The field cycles with standard cycle lengths of up to 22.50 m, were constructed in advance and the second formwork carriage was used to form the areas of the piers. Reinforcement work was carried out in advance on two additional sets of slab formwork, which were then subsequently attached to the formwork carriage for concreting operations. In regular 2-day cycles, one section could be always concreted while the other carriage was moved to the next area by means of heavy duty rollers.

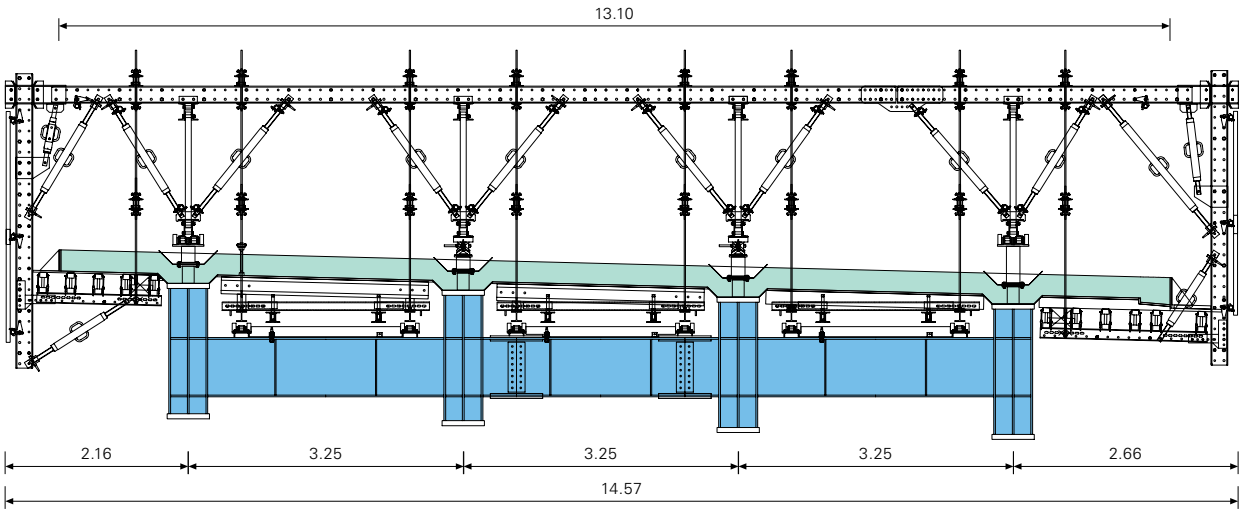
As all system components of the VARIOKIT Engineering Construction Kit are standardised, i.e. rentable, hardly any special parts were required. This made the PERI formwork carriage solution extremely cost-effective. Nevertheless, VARIOKIT was very flexible in its use because individual components were optimally matched to each other to suit the requirements of the construction site.



With the help of the two formwork carriages and two additional sets of slab formwork in advance, the field and pier concreting cycles of up to 22.50 m were carried out using the so-called back-step method.

With the diagonal spindles, all inclinations and heights for the cantilever formwork could be easily adjusted.

The two parallel superstructures of the the 22-field bridge were built using the steel composite construction method.



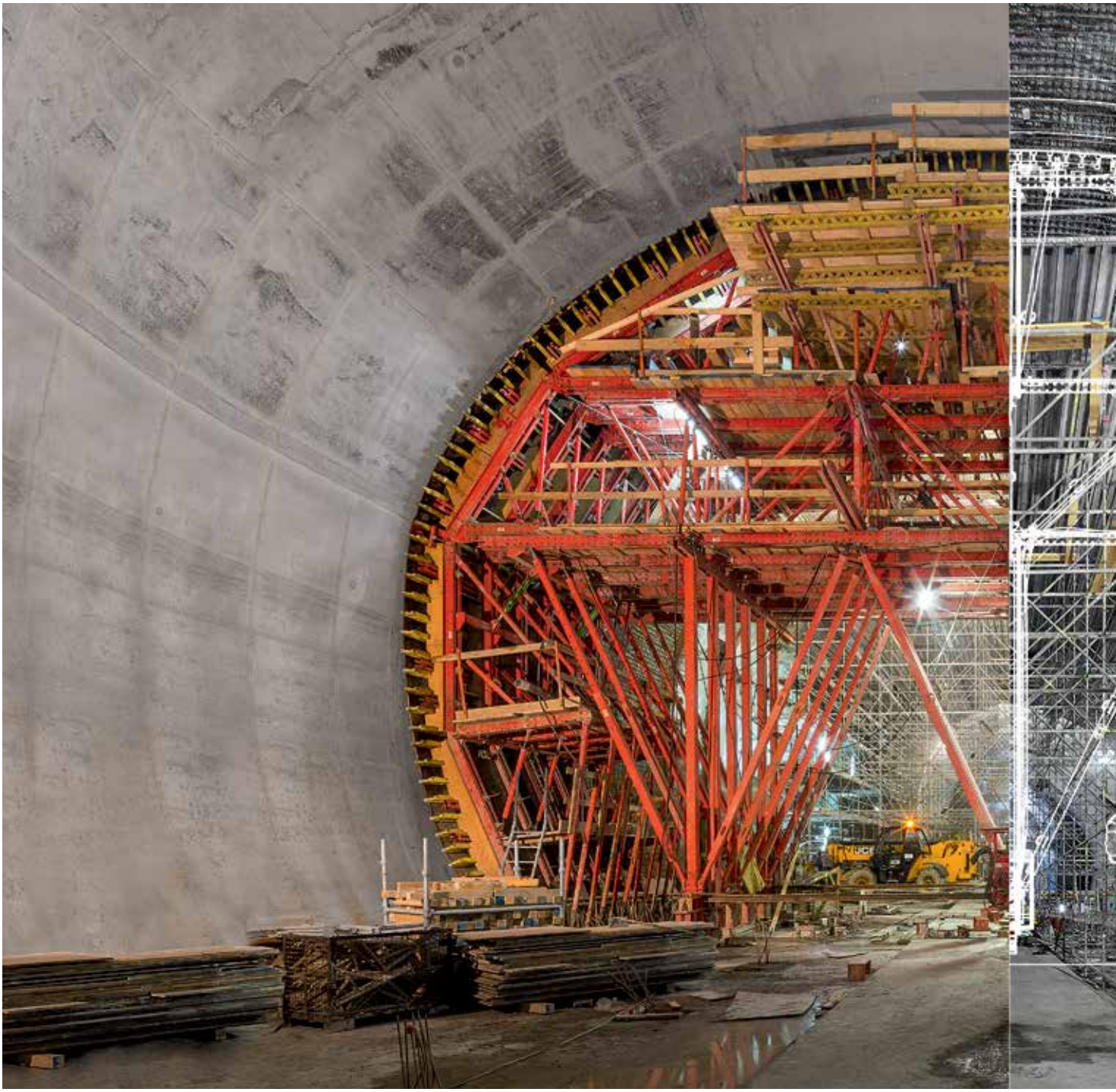
The loads from the 25-cm-thick carriageway slab were reliably transferred into the steel girders via the VARIOKIT Composite Formwork Carriage.

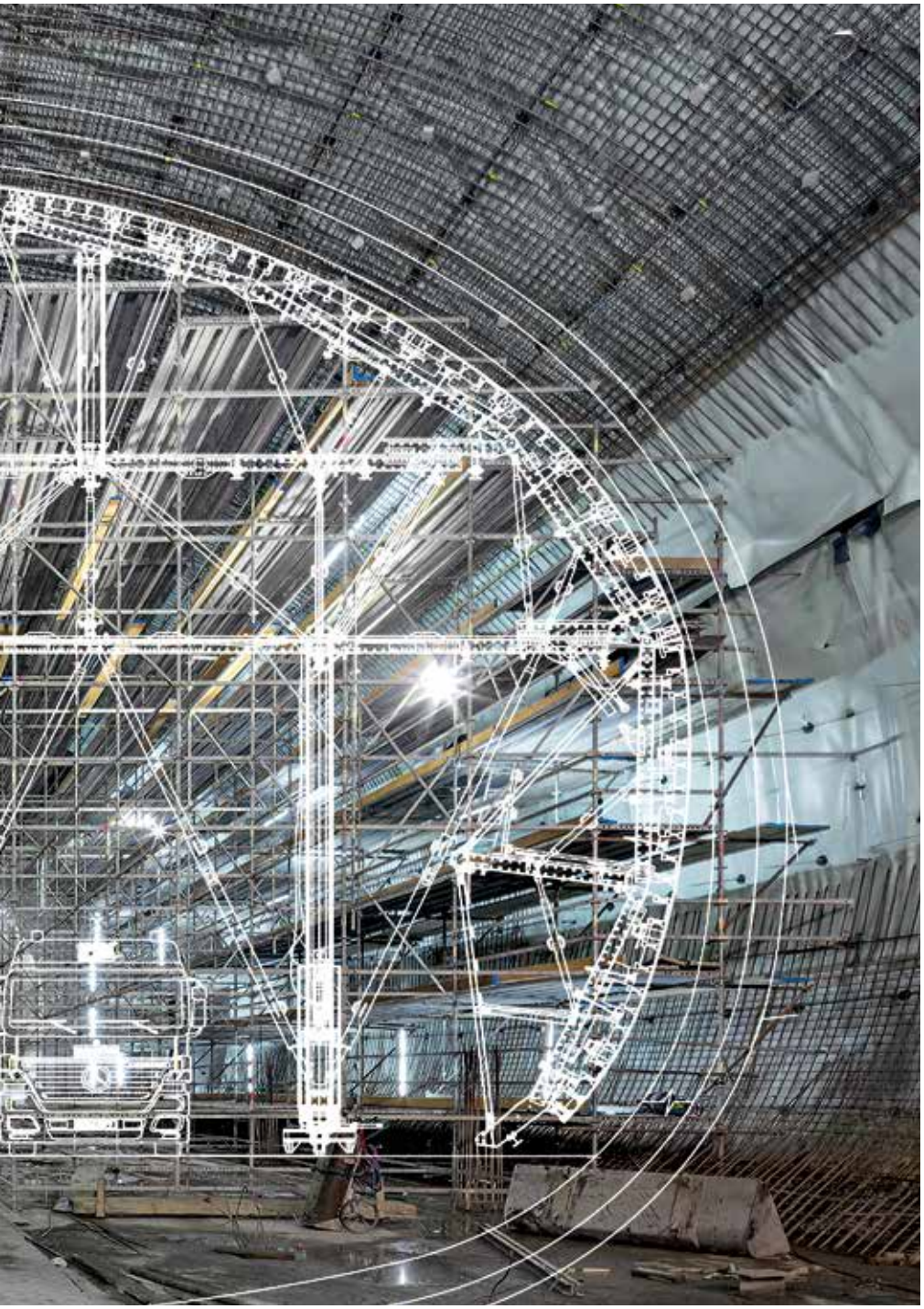
Project examples

Ruhrtal Bridge, Bermecke, Germany

Pulvermühle Viaduct, Luxembourg

VARIOKIT system solutions and services from one source





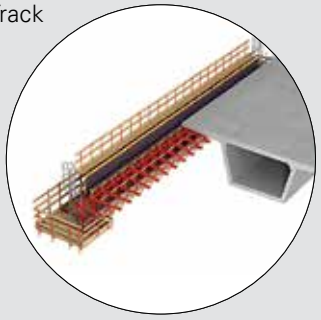
Every bridge and tunnel construction requires project-related planning. With its extensive know-how and expertise, PERI not only provides the required materials but also the complete planning services from a single source.

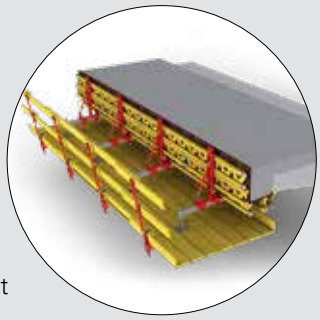
PERI solutions take into account building and assembly processes along with the maximum functionality for the construction work. With well-engineered technical planning, PERI provides cost-efficient solutions that are optimised on a project-specific basis and are precisely tailored to meet the requirements of the jobsite. Technical project solutions with VARIOKIT and services from one source accelerate the work process enormously.

Applications with the VARIOKIT Engineering Construction Kit

VARIOKIT solutions are typically comprised of around 95 % rentable core and system components. In order to fulfil specific project requirements, only a few special components are needed.

VGB Cantilevered Parapet Track





VGK Cantilevered Parapet Bracket

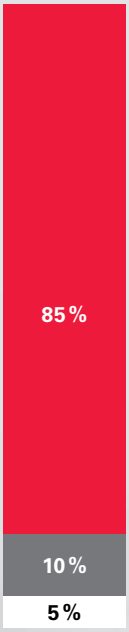
VGW Parapet Carriage

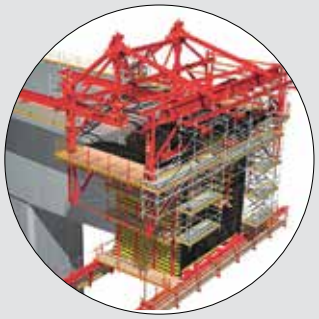
VCB Cantilever Bracket

VTC Tunnel Formwork Carriage

VRB Heavy-Duty Truss Girder

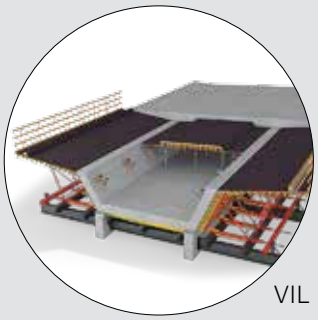
VST Heavy-Duty Shoring Tower





VBC Balanced
Cantilever Equipment

85 % core components
10 % system components
5 % special components



VIL Incremental Launching Facility

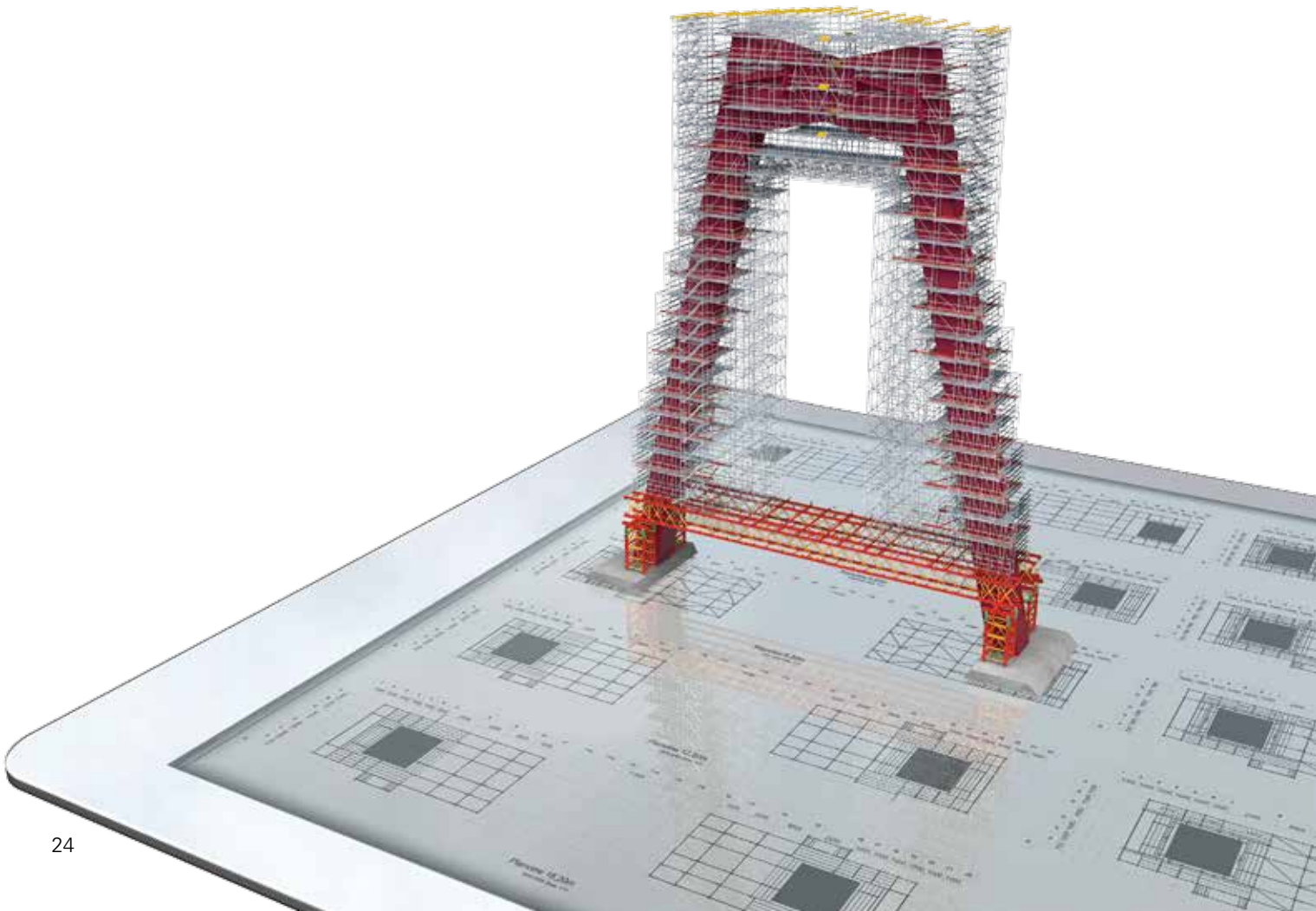
VCC Composite Formwork Carriage

Individual services for customised bridge and tunnel construction

In addition to the required materials, PERI also provides a comprehensive range of expertise as well as the complete planning services from a single source. PERI solutions take into account building and assembly processes along with the maximum functionality for the construction work. For the planning, PERI pays great attention to maximising utilisation of the rentable core and system components in order to provide customers with particularly cost-effective solutions.

Around 1,300 PERI engineers worldwide plan and design formwork and scaffolding solutions for cost-effective executions. All PERI engineering planning services are aimed at ensuring that PERI formwork and scaffolding systems in construction operations are always used in line with time, cost and quality standards. The basis for this are the execution plan records, which are based either on 2D-views and sections or realistically visualised 3D building models. As a result, technical solutions are developed with customers that optimise the use of materials and the construction process itself.

These planning-related services from PERI Engineering are supplemented by verifiable, static calculations as proof of stability for formwork and scaffolding operations, as well as by project-specific installation and assembly plans for the professional implementation of special applications. Construction site personnel can use the plans to assemble the individual PERI components correctly and prepare them for use.



A consistent CAD planning process is realised by bundling the formwork and scaffolding planning.

Implementation plans are coordinated, and it becomes much easier and quicker to organise subsequent plan changes and put them into practice.

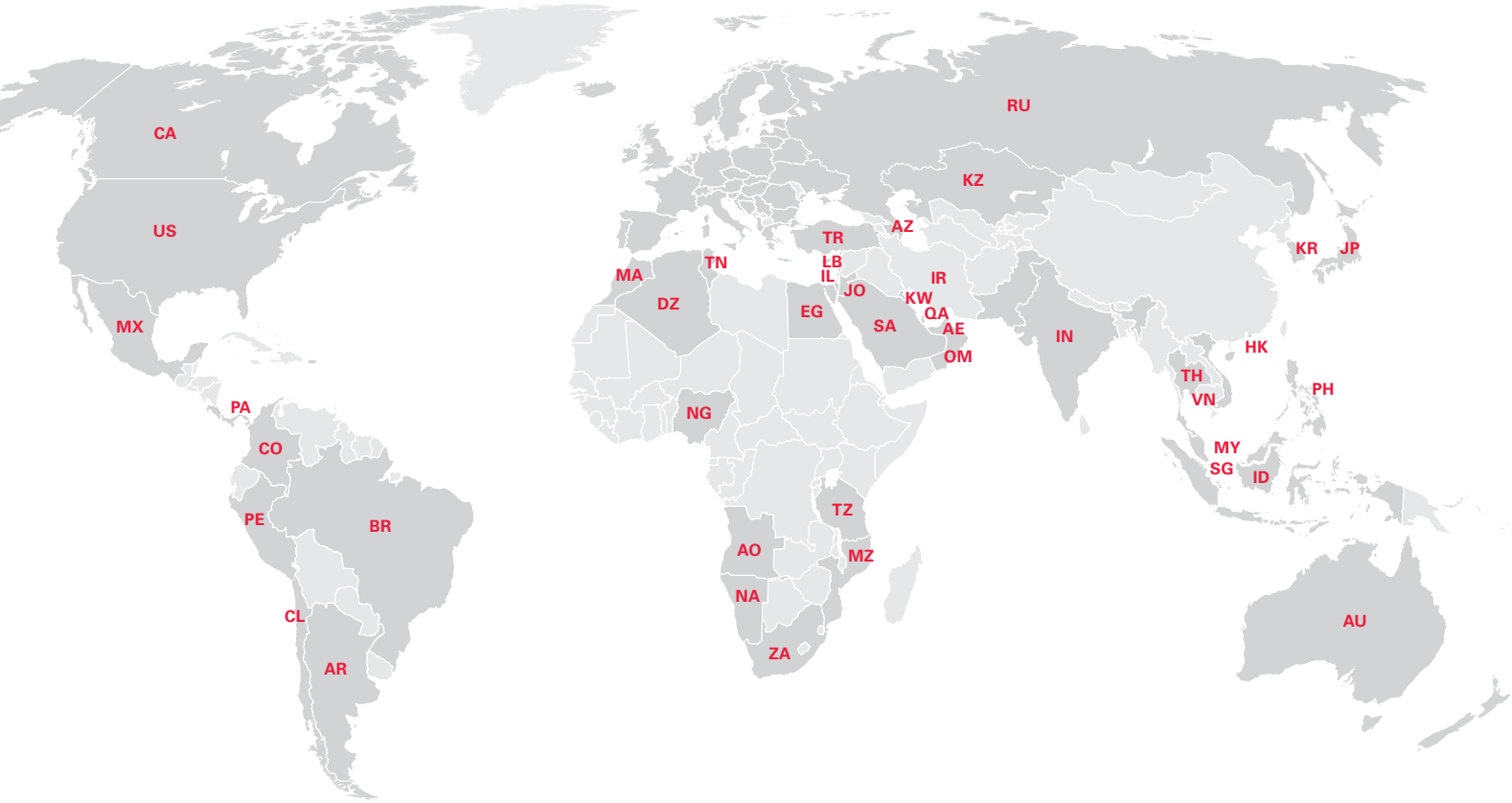
PERI supervisors also explain plans and parts lists along with providing information on the maintenance, cleaning and storage of PERI materials. If required, they will provide the construction team with comprehensive on-site support to ensure efficient use of PERI system equipment from the very start.

In order to minimise on-site assembly times and maintain tight construction schedules, PERI also provides – if required – pre-assembled units to the construction site. VARIOKIT is extremely cost-effective, especially with short utilisation times, thanks to the rentable components and assembly advantages.

When it comes to BIM, PERI has been one of the leading companies in the industry for many years now and can already show a number international project references that have been successfully developed with customers using BIM principles.

Through the additional integration of the time and cost factors, the 3-dimensional visualisation of the planning gradually turns into a 4D or 5D model. Additional process data relating to formwork and scaffolding technology, such as required plan changes, automated collision checks, safety checklists and QR codes for object navigation, is documented and tracked in a mobile building information management system. All relevant data is available on the construction site via tablet solutions for day-to-day operations.

PERI International



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