PERI

Self-Climbing Technology

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Technology
References

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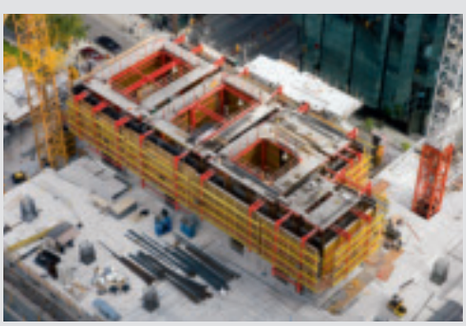
Contents

Bridges

Towers



RBC Center, Toronto, Canada

Fuldatal Bridge, Kassel, Germany

Terzo Palazzo Administration Building, Bologna, Italy

Working quickly and safely at great heights

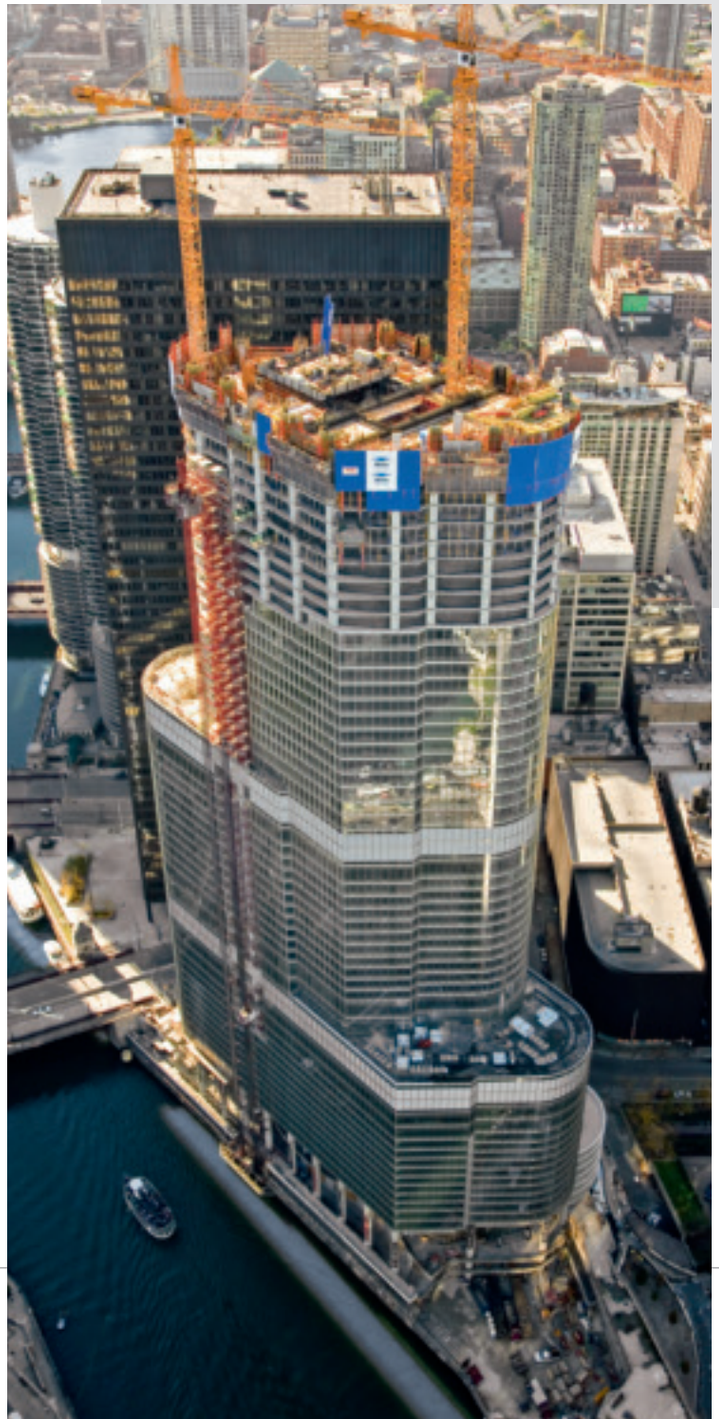
PERI self-climbing technology for bold and striking structures around the world

Today's types of construction and range of methods allow the realisation of impressive architectural designs. In the process, PERI supports building contractors worldwide. PERI solutions ensure that construction progress is carried out more cost-effectively as well as increasing safety levels for site personnel.

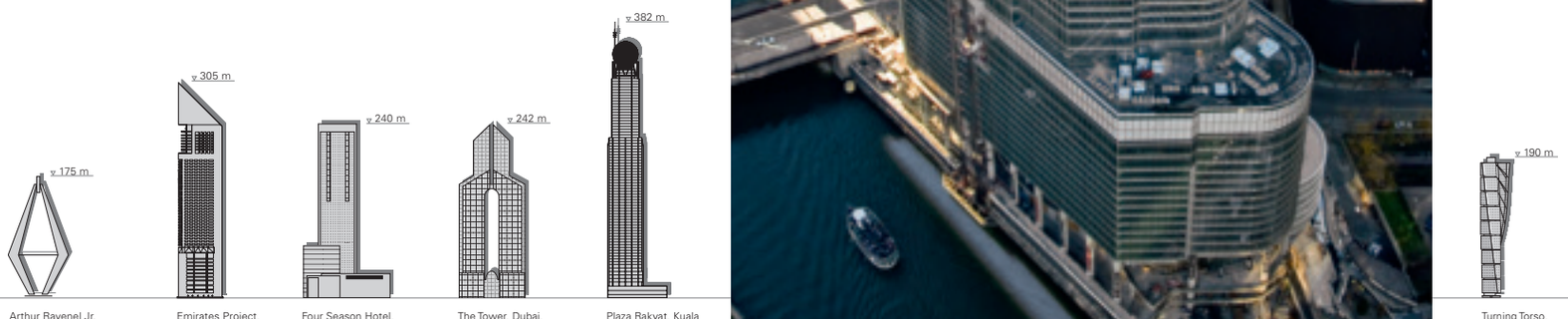
With the help of the PERI self-climbing technology, PERI engineers have rationalised construction sequences to such a degree so that only physical principles, e.g. setting time of the fresh concrete, actually limit further acceleration of the building progress.

In this respect, PERI specialists provide valuable advice and support for each high building project. With their know-how and vast experience, they can find the most economical solutions for a broad range of diverse projects.

Trump International Hotel & Tower, Chicago, USA



Over 300 spectacular, high structures have been climbed so far using the PERI technology. New projects are added on an almost daily basis.



Arthur Ravenel Jr. Bridge, Charleston, USA

Emirates Project, Dubai, UAE

Four Season Hotel, Miami, USA

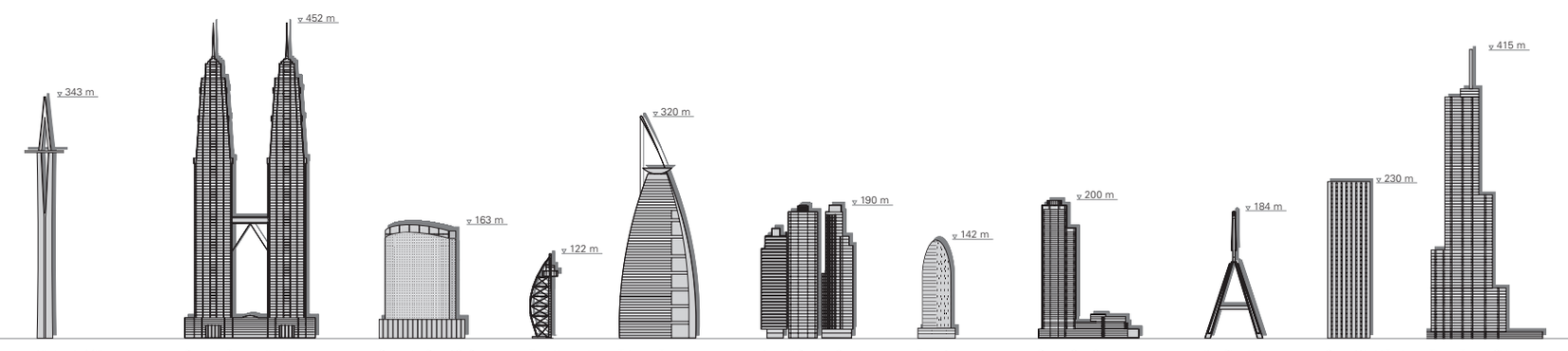
The Tower, Dubai, UAE

Plaza Rakyat, Kuala Lumpur, Malaysia

Turning Torso, Malmö, Sweden

Weichsel Bridge, Warsaw, Poland

Al Rostamani Tower, Dubai Marina, UAE



PERI Self-Climbing Formwork

The experience of almost 40 years construction technology

Milestones of the PERI climbing technology

2005 ... RCS Rail Climbing System
crane-dependent and self-climbed

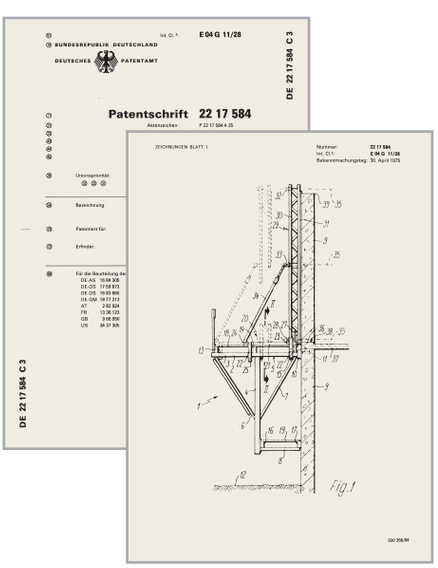
1993 ... ACS Automatic Climbing System
self-climbed

1988 ... CB Climbing System with strongback
crane-dependent

1972 ... PERI Climbing and Travelling Formwork
crane-dependent

The development of the climbing formwork-systems began with PERI patent DE 2217 584 in April 1972. For the construction of the Dresdner Bank building in Mannheim in 1972, PERI used large formwork elements on a retractable climbing scaffold for the first time.

At that time, this bold design significantly rationalised the construction of high buildings because formwork and climbing scaffold could be lifted with a single pick of the crane. The formwork was retracted on the scaffold, cleaned and then closed again. Further development resulting in lifting such climbing units without the use of a crane to the next casting segment was not far away. The savings made on crane requirements made climbing formwork incomparably fast and inexpensive.


BUNDESREPUBLIK DEUTSCHLAND
DEUTSCHES PATENTAMT
Int. Cl.: E 04 G 11/28
DE 22 17 584 C 3
Patentschrift 22 17 584
ZEICHNUNGEN BLATT 1
FIG.1

Patent specification issued by the German patent office in 1972.

Already in the 1970s, the first projects were built with PERI self-climbing systems, e.g.

1977 Reichenberger Grund Valley Bridge, Germany

1978 Gutachtal Bridge, Germany

1983 Rombachtal Bridge, Germany

1987 Fuldatal Bridge, Germany

1988 Olympic Bridge, Seoul, Korea

1990 Trianon Highrise Complex, Frankfurt, Germany

Today's modular systems - PERI ACS Automatic Climbing System and RCS Rail Climbing System - are products resulting from modern engineering expertise, efficiency and cost-effectiveness, and are based on the experience gained through successfully completed projects.

Photo (right): the new Hong Kong Shanghai Bank Corporation building in London. 2,310 m^2 of wall formwork for the construction of the building cores were hydraulically climbed in 4-day cycles up to a height of 230 m.

The safety concept
Working safety with system

■ Safety for site personal

Wide, all-round protected working platforms on the formwork scaffolding and climbing protection walls at the slab edges serve as effective safety barriers against falling and offer protection against wind and weather when working at large heights.

■ Safety during climbing

The ACS and RCS climbing devices function extremely reliably by means of sophisticated control processes and robust individual components. With both systems, any asymmetrical load distribution is adjusted by the hydraulic system. This means that the platforms are always climbed in a horizontal position.

■ Safety at high wind loads

The scaffold units are connected to the building at all times regardless whether during a crane-dependent climbing procedure or if self-climbed. Self-climbing operations can take place during wind speeds of up to 72 km/h.

By default, the construction has been designed for high wind speeds according to German standards. For special requirements, statical proof can also be provided for much higher wind speeds of over 200 km/h.

■ Safety through PERI service

Experienced assembly personnel, supervisors and engineers are available at any time for assembly and training as well as providing help and support beyond the initial phase.

PERI engineering ensures the optimal adjustment of the formwork and scaffolding solution to the building itself through intelligent combinations of the modular versions of ACS and RCS. If required, projects can be supplemented with customised special solutions.

■ Safety through quality

Internal company procedures are organised according to the EN ISO 9001 Quality Management System which provides the basis for the high development standards and the highest possible quality of the PERI equipment. The PERI climbing anchors are officially approved and the quality of the components are controlled throughout.

Photo (top):
Completely enclosed building edges with PERI RCS.

Photo (bottom):
Generously-dimensioned working platforms on ACS R units.

Faster construction progress with PERI technology
Higher productivity through optimised processes

Through crane-independent forming, striking and climbing, work processes are optimised on the construction site and makes them independent of each other. This allows the planned operational sequences to be maintained and which can even be accelerated.

PERI ACS and RCS can be climbed during all weather conditions. Site personnel are able to work in comfortable conditions on the platforms as though working on the ground. The working platforms can be enclosed to provide protection against the weather.

With the resulting feeling of safety, worker productivity also increases. The working platforms are able to carry high loads; for example, the storing of reinforcing steel for the next climbing section. Even the placing boom for the concrete pump can climb on the ACS self-climbing system if required.

With experience values of 0.1 h/m² for pylons and 0.2 - 0.4 h/m² for highrise buildings, results are achieved which correspond to an efficient "on ground" construction project.

PERI ACS climbing device

Only nature climbs more elegantly and quieter: fixed at the top - pull up - fixed at the bottom - push up. Up or down, just like the PERI ACS climbing device.

Climbing Unit ACS 100
Reliability with 10 t lifting capacity

The climbing mechanism is the heart of all ACS systems, with a lifting power of 100 kN. The positively-controlled climbing device lifts the climbing rail and formwork scaffolding to the next casting segment safely and jerk-free. All loads are safely transferred during every climbing phase.

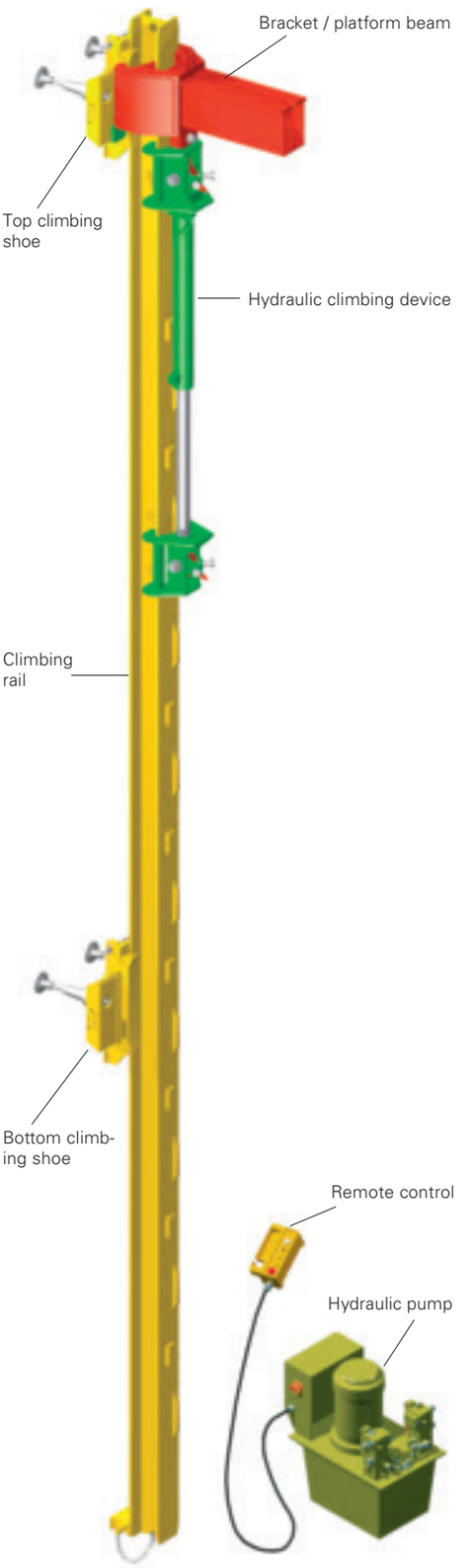
Due to the almost noiseless PERI climbing hydraulic, working outside of normal working hours is possible without disturbing surrounding residential areas.

The stroke speed is 0.5 m/min whilst the effective climbing speed is 0.3 m/min.

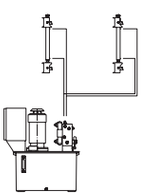
After approx. 15 minutes, the climbing procedure for a floor of average height is completed.

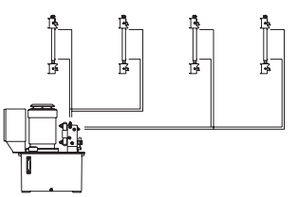
Individual ACS climbing units can be combined due to the different hydraulic pumps that have been fitted. These units can be climbed individually as well as together at the push of a button on the remote control.

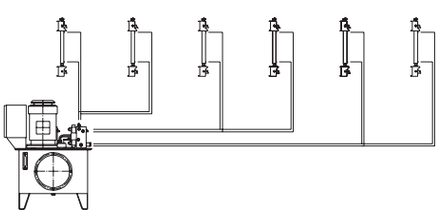
Four different hydraulic pumps are available. (2, 4, 6 and 8-fold).

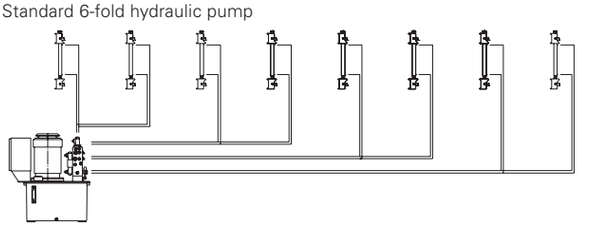


Hydraulic versions


Standard 2-fold hydraulic pump

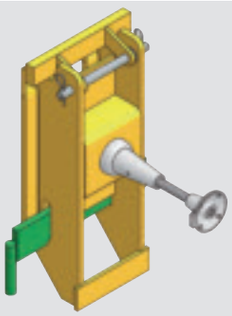

Standard 4-fold hydraulic pump


Standard 6-fold hydraulic pump

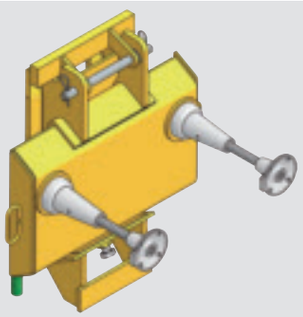

Standard 8-fold hydraulic pump

Anchoring to the building
Safety through quality

The loads from the climbing scaffold must be safely transferred through the anchors into the building. This is particularly important because very often the system is climbed the day after concreting has taken place.

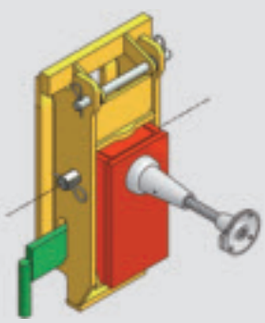


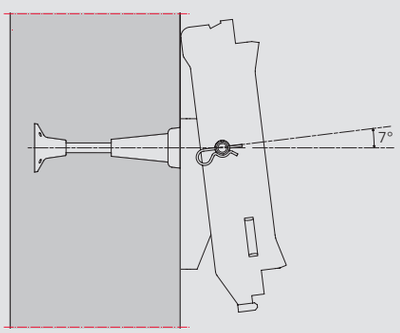
Climbing Shoe I



Climbing Shoe II with horizontal adjustment

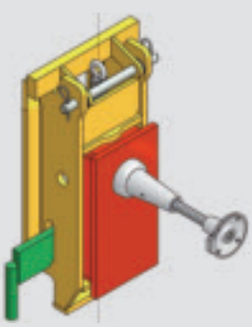
After taking into consideration individual factors such as the structure of the building, loading, wall thickness and required concrete hardness, the optimum climbing shoe and anchor type are selected along with determining their position. All compression and tension forces can then be safely transferred into the wall.

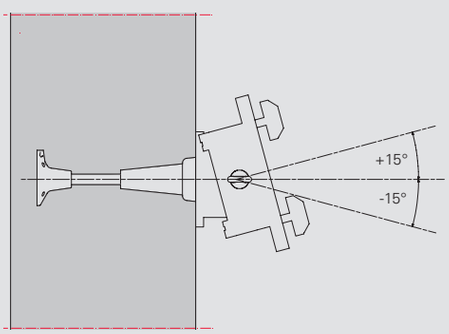




Climbing Shoe IV with anchoring shoe; can be pivoted on the horizontal axis by up to 7°

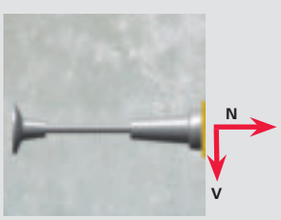
For use on circular structures or for climbing over wall off-sets, the climbing shoe IV from PERI provides a flexible alternative for anchoring to the building.



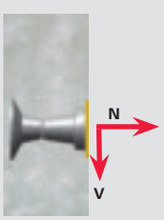


Climbing Shoe IV with anchoring shoe; can be pivoted on the vertical axis ± 15°

PERI climbing anchors are approved by the building authorities. This guarantees a high level of safety to the user and saves on the need for expensive individual statical proof.



Scaffolding Anchor - Climbing Cone for 90 % of all cases



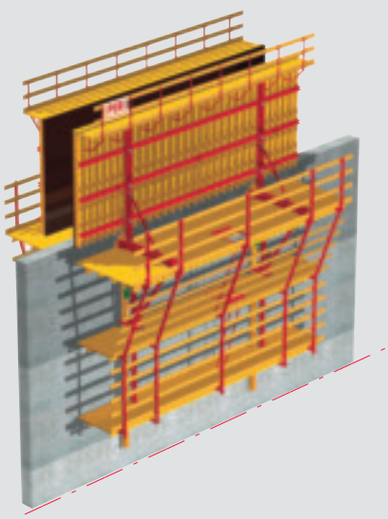
Scaffold Anchor - Screw-On Cone for high shear loads and small tension loads

Five Variations of the Modular ACS System

A flexible construction for maximum building adjustment

When choosing the most suitable ACS version for a particular project, the following factors are decisive: the form of the building, the required construction sequence, specified cycle times, reinforcement work, and the requirement that the placing boom also has to be climbed.

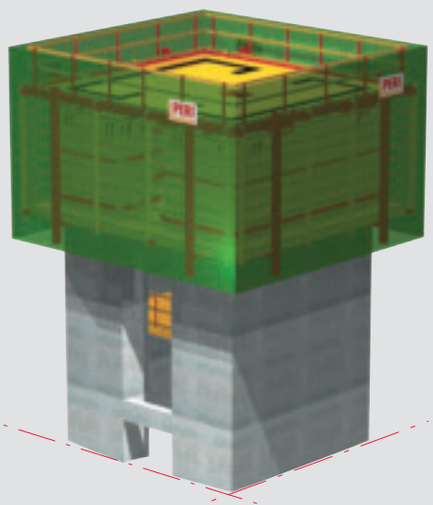
In order to ensure achieving an optimal sequence of operations on the same building, the PERI ACS versions can be used side by side or even combined.



ACS R (R=Regular)

This is the most widely used version. The formwork is open at the top which means that the reinforcement can be pre-installed over large areas.

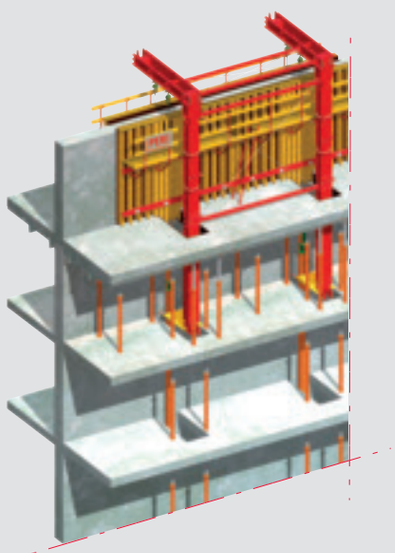
The movable formwork provides sufficient space for all cleaning and reinforcement work when retracted.



ACS P (P=Platform)

The solution for advancing cores of high-rise buildings and tower-like structures.

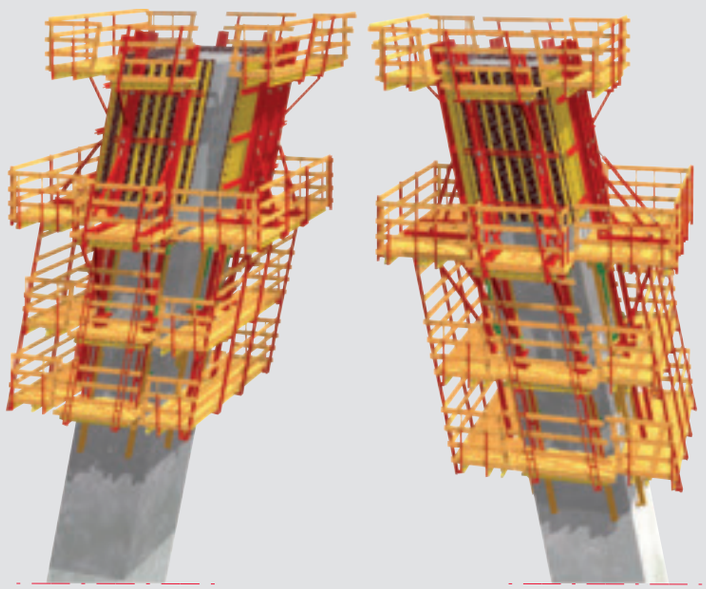
The platforms provide generous storage and working areas. With the ACS P system, only a few platform beams cross the walls. This means that the reinforcement can be partially pre-fabricated.



ACS G (G=Gallows)

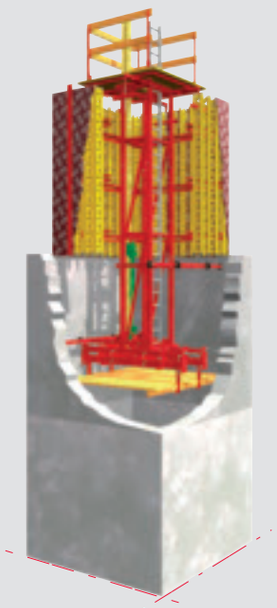
Here, slabs and walls can be poured monolithically.

Both sides of the formwork are movably suspended on the cantilevered set of gallows. The brackets are braced using the slabs themselves and are climbed through box-outs in the slabs. Even round structures or complicated ground plans can be cost-effectively realised with ACS G.



ACS V (V=Variable)

An integral part of this adjustable version is a working platform which can also be horizontally used on inclined structures such as bridge pylons. The carriage always moves in a horizontal position which means it does not have to contend with the force of gravity. Horizontal working platforms ensure safe and ergonomic working conditions at great heights, with no risk of slipping for site personnel and equipment.



ACS S (S=Shaft)

The self-climbing shaft formwork also allows the cost-effective use of self-climbing technology for relatively small elevator shafts or stairwells. Arranged in the centre, a climbing device serves in a standard way to raise the climbing frame with suspended formwork and trailing work platform to the next concreting section.

All versions work with the same ACS 100 climbing unit.

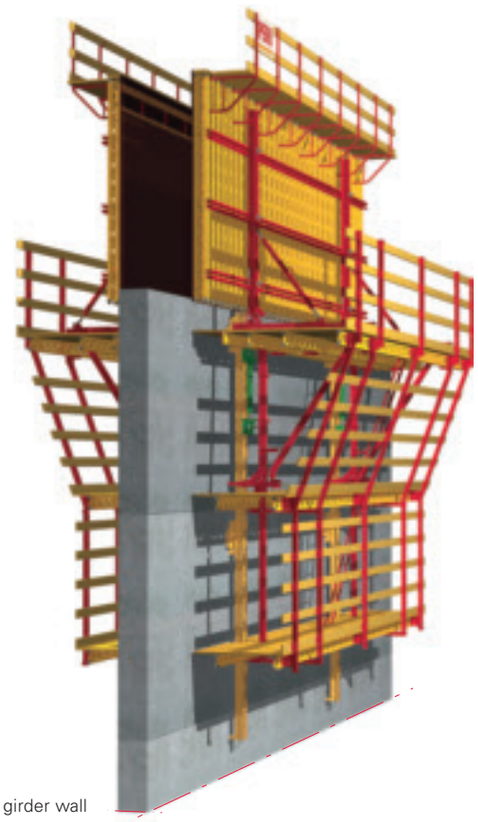
PERI Self-Climbing Formwork ACS R
Standard version for 80 % of all operations

The PERI ACS R self-climbing formwork system (R=Regular) is used everywhere where large areas have to be formed and where the walls have to be fully accessible from above. Furthermore, pre-assembled reinforcing cages can be lifted into position unhindered.

Wide spacing between the brackets therefore reduces the number of scaffolding anchors resulting in less plugged areas on the wall. A lot of space remains between the brackets for embedded parts, window and door box-outs as well as connections for slabs and beams.

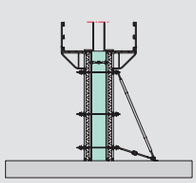
The working platforms are generously dimensioned with 2.40 m widths which provide sufficient space for site personnel. A large retracting distance of 80 cm for the smooth-running carriage alleviates all formworking tasks and reinforcement work.

The quiet and even climbing procedure characterizes the high safety and quality levels of the ACS 100 climbing unit.

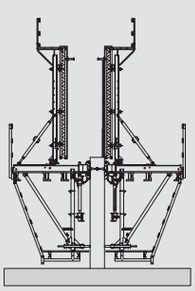


ACS R with retracted VARIO girder wall formwork on one side.

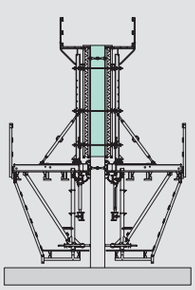
Installation and climbing sequence
Erection Phase



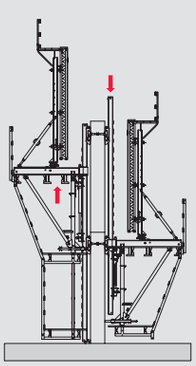
1st Step
Shutter formwork on one side, Position and secure leading anchor, Reinforce, Close formwork, Concrete



2nd Step
Attach climbing shoe
Attach climbing scaffold
Shutter formwork on one side, Position and secure leading anchor, Reinforce

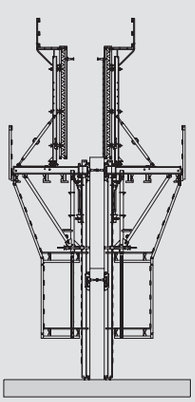


3rd Step
Close formwork, Concrete, Strike Clean formwork

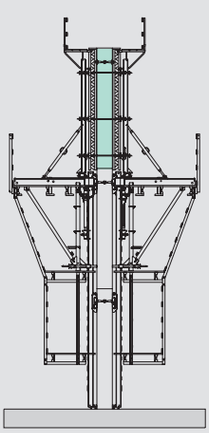


4th Step
Attach climbing shoe, Insert climbing rail, Climb hydraulically, Attach finishing platform

Climbing Phase



5th Step
Shutter formwork on one side, Position and secure leading anchor, Reinforce

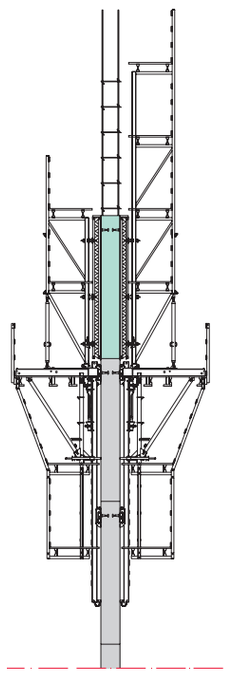


6th Step
Close formwork, Concrete, Strike Clean Formwork

The ACS R can be extended by means of a few simple components in order to achieve optimum adaptation to any building. Examples:

- Additional working platforms for reinforcement work in advance (for pylons)
- Widening of the working platforms in order to, for example, make use of the full width of the shaft when these are being constructed
- Access bridges and attached stair towers to allow safe access to the climbing scaffold.

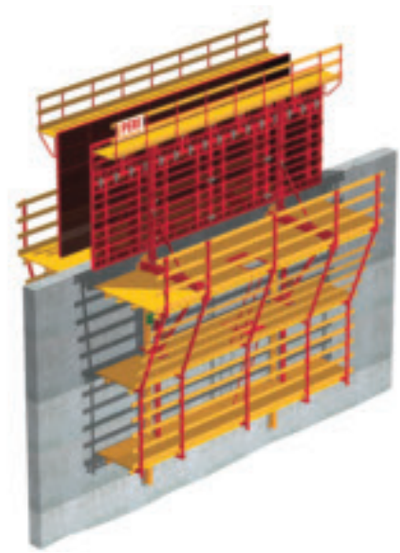
Climbing is always carried out with the climbing unit ACS 100.



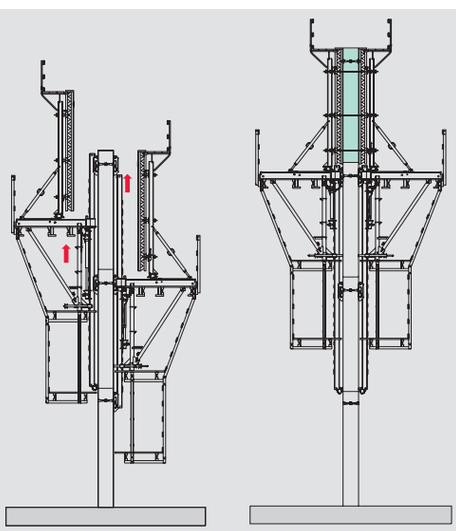
Example of the ACS R with additionally integrated working platforms, here for reinforcement work.

ACS R and VARIO girder wall formwork for construction of the reinforced concrete core of a 134 m high skyscraper in Chicago, USA.

ACS R combined with TRIO panel formwork.



Cleaning and reinforcement work can be safely and efficiently carried out under the protection of the retracted formwork.



7th Step
Attach climbing shoe, Hydraulically climb the rails and scaffolds

8th Step
Place formwork on one side Position and secure leading anchor Reinforce Close formwork Concrete

PERI Self-Climbing Formwork ACS P

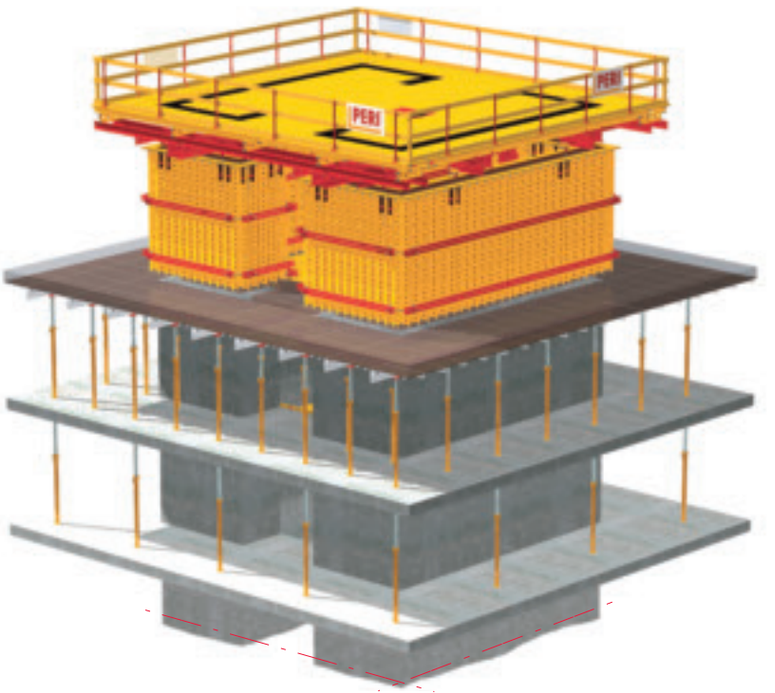
Complete core formwork is climbed at the push of a button

The PERI self-climbing formwork system ACS P (P=Platform) is a complete forming machine for highrise building cores and tower-like structures.

All formwork, working scaffold, storage areas and equipment used to form the internal and external walls are self-climbed in one single operation. During the climbing procedure, the complete climbing unit is enclosed. No open edges are created which could be a fall hazard.

The powering mechanism for climbing the complete scaffold is the PERI ACS 100 climbing unit.

Particular attention was paid to ensure unhindered movement on all working levels. Site personnel can freely access the formwork and climbing unit at all times.



ACS P with subsequent slabs. The wall formwork is suspended on panel carrier beams which can be attached as required on the platform.

The vertical walls and storey slabs are poured in one step. This procedure results in a lot of cost-savings for the construction company as the customary screwed-on connections between the slab and wall are no longer required.

Installation and climbing sequence

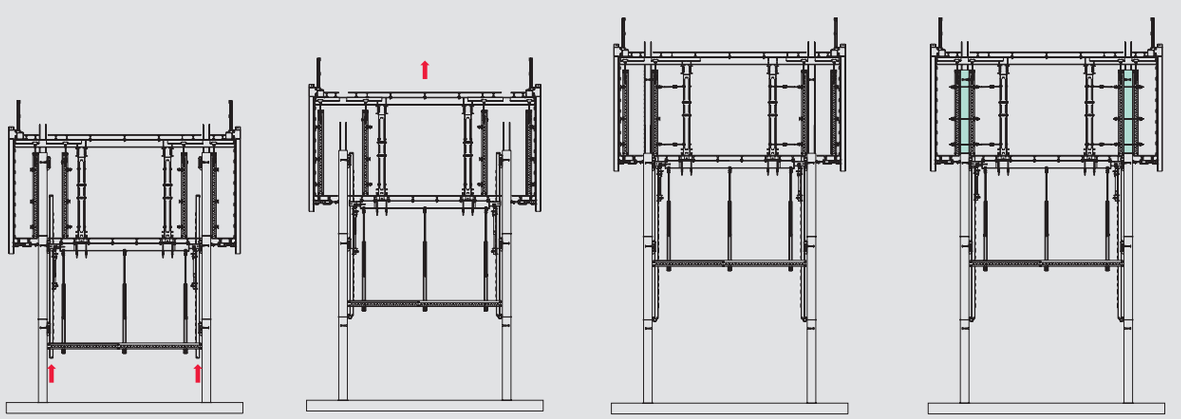
1st Step
Strike, Attach climbing shoe, Climb rail, Remove trailing climbing shoes and anchors

2nd Step
Climb climbing scaffold Position climbing scaffold on climbing shoe

3rd Step
Place internal formwork, Clean formwork, Reinforce, Install leading anchor Shutter

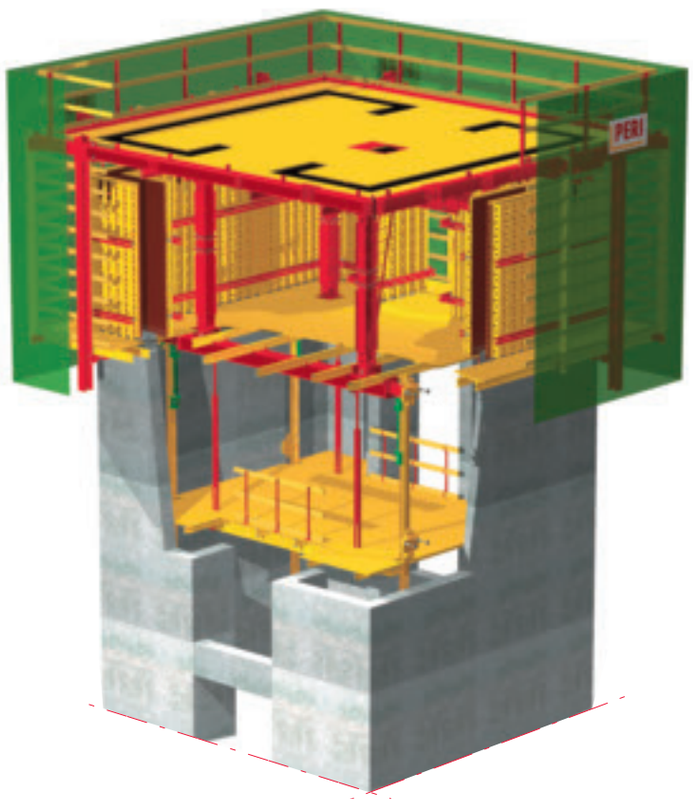
4th Step
Close formwork, Concrete

Climbing Phase
Presentation with external working platforms on advancing core



The core proceeds ahead of the slab construction by several floors. A steel structure, fitted for the building, carries the whole weight of the platform including working and live loads. All horizontal loads are transferred into the building without requiring any bracing. There are few crossing points over the walls which cause interference. In addition, large reinforcement cages can be lifted into position.

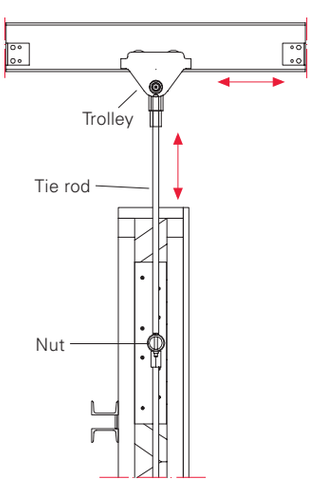
Project: Tour T2, Defense-Courbevoie, Paris, France

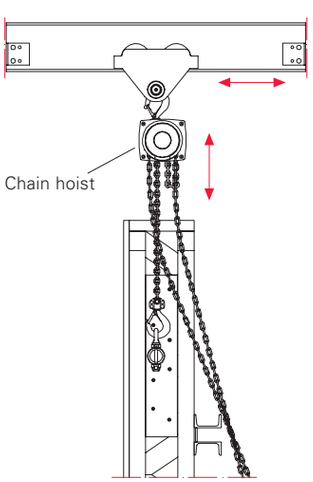


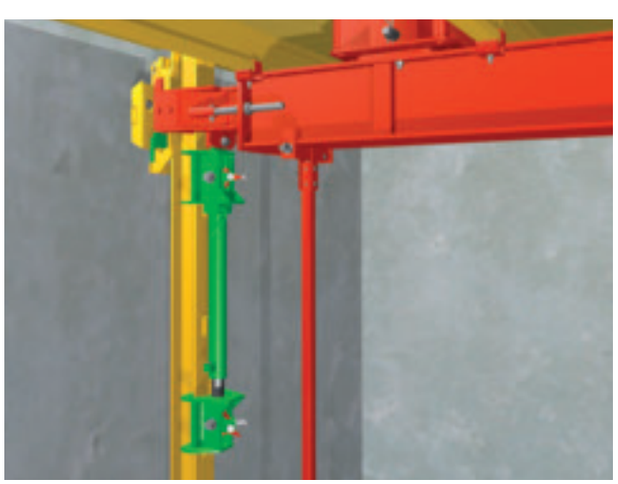
The staircase core climbs ahead of the floor slabs. The all-round external working platforms can be completely enclosed.

Element suspension
The formwork is suspended by means of a smoothly-running trolley on panel carrier beams which can be arranged as required. The formwork unit is height-adjustable. When concreting the wall and slab in one pour, the area under the formwork must be accessible. For this, the formwork unit is lifted using a chain hoist (right).

Climbing mechanism
ACS 100 with self-actuating telescopic platform cross beams which compensate for building tolerances and planned wall breaks accordingly. The finishing platform is simply mounted on the cross beam by means of a clamp.



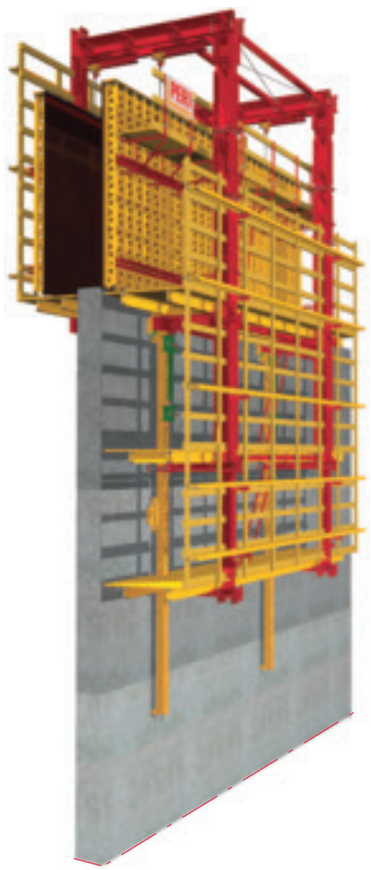




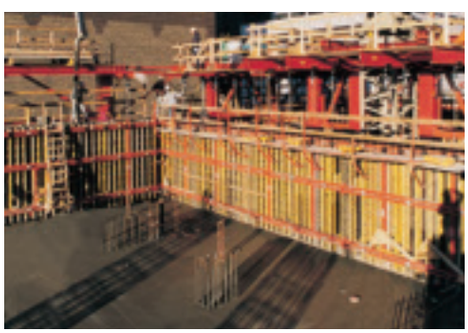
PERI Self-Climbing Formwork ACS G
Gallow version for flexible use

The self-climbing version ACS G (G=gallows) functions with a bracket which allows both sides of the formwork to be suspended on one set of gallows. Even the opposite working platform can be attached to these gallows.

The smooth-running suspended formwork is horizontally movable on both sides and easily adjustable. On circular structures, the rails for the formwork are pivoted parallel to radially-arranged consoles.



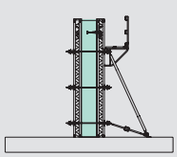
ACS G used on a facade or on advancing walls.



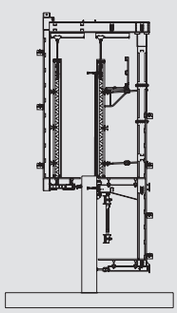
Project: Park Tower, Chicago, USA (see report Page 52)

Formwork suspended on the gallows with height adjustment, movable on manualy-operated carriage.

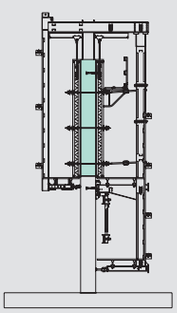
Installation and climbing sequence
Erection Phase



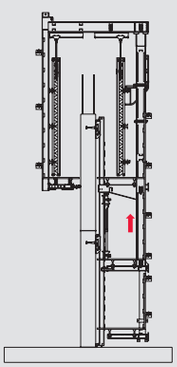
1st Step
Place formwork on one side, Position and secure leading anchor, Reinforce
Close formwork,
Concrete



2nd Step
Install climbing shoe
Attach climbing scaffold
Place formwork on one side, Position and secure leading anchor, Reinforce

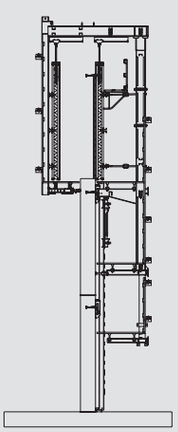


3rd Step
Close formwork
Concrete
Strike

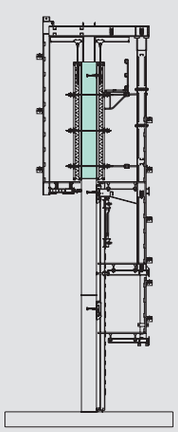


4th Step
Mount climbing shoe
Insert climbing rail
Climb hydraulically
Attach finishing platform
Clean formwork

Climbing Phase



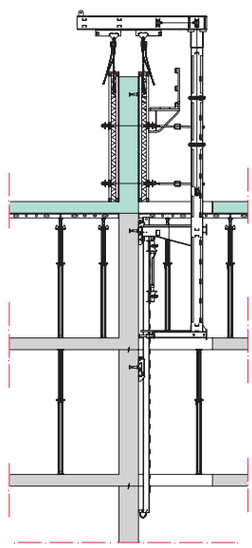
5th Step
Place formwork on one side, Position and secure leading anchor, Reinforce



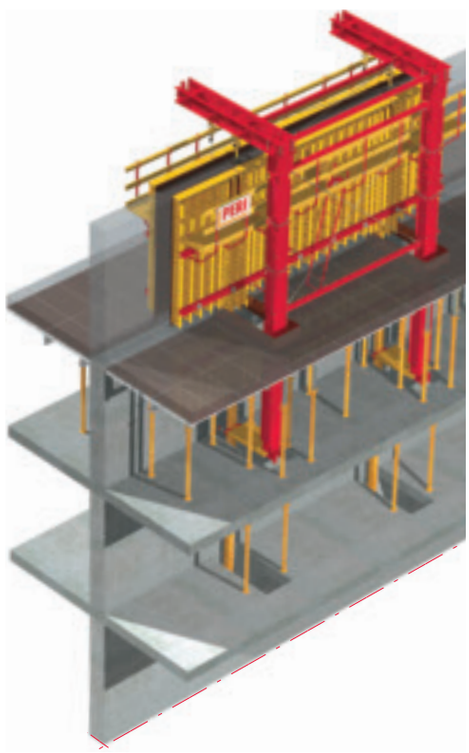
6th Step
Close formwork
Concrete, Strike,

With bracing positioned at the top, it is possible to climb through box-outs in the slab. This results in a construction method whereby the wall and slab can be concreted in one pour. Shortened cycle times along with the savings made due to no expensive reinforcement connections for the slab, make this method of construction extremely cost-effective.

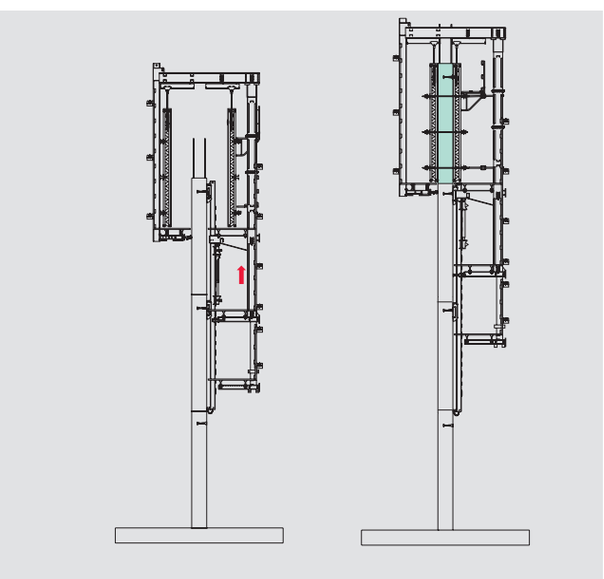
Here too, the ACS 100 climbing mechanism ensures safe and smooth operational sequences when moving without a crane.



Drawing, right: the formwork elements are freely suspended above the ground. The slab is concreted first, immediately followed by the wall.

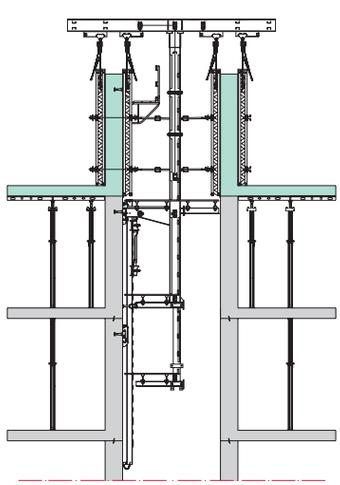


The ACS G climbing scaffold climbs through box-outs in the slabs which are subsequently closed with a minimum of effort. Chain hoists simplify lifting operations of the formwork.



7th Step
Mount climbing shoe
Climb rail and scaffold
Clean formwork

8th Step
Place formwork on one side
Position and secure leading anchor, Reinforce, Close formwork, Concrete



Double-sided gallows:
ACS G scaffold unit climbing in a shaft.

PERI Self-Climbing Formwork ACS V

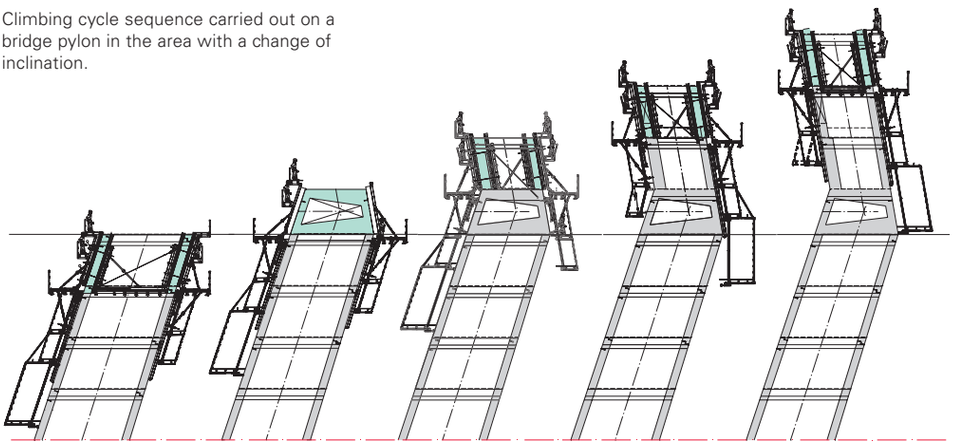
Safe working conditions on inclined structures

For steeply-inclined walls, the continuously adjustable ACS V (V=variable) is used. Fields of application include forward or reversed-inclined pylons or walls, as well as tapering cross-sections in towers.

Despite the inclination of the building, the different platforms are always in a horizontal position. This ensures safe and spacious working areas for reinforcement, forming, concreting and re-working on all structures.

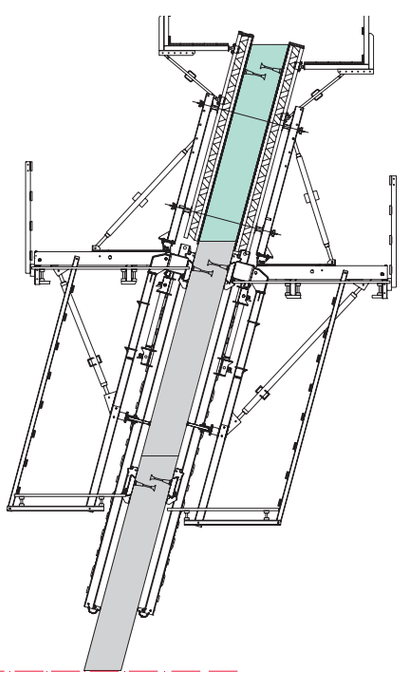
Due to the horizontally-positioned carriage, the formwork is easy and safe to move. Here, too, the proven ACS climbing device stands for safety and simple operations.

Climbing cycle sequence carried out on a bridge pylon in the area with a change of inclination.



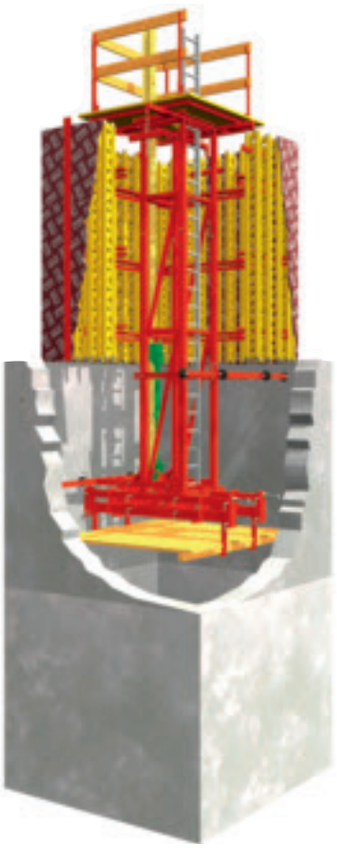
Project: Uddevalla Bron, Sweden

Section: ACS V
Concreting, working and finishing platforms in horizontal positions.



PERI Self-Climbing Formwork ACS S

Inexpensive solution for shaft construction



3D model of the ACS S.
When in a working condition, the framework tower carries the suspended internal formwork.

The self-climbing formwork ACS S (S=shaft) is the preferred choice for closed, individual or multi-cellular concrete structures such as elevator shafts, stairwells or service shafts.

ACS S is an independent self-climbing system, hydraulically-driven by only one ACS 100 climbing device. On the inner-positioned climbing rail, the complete internal formwork including the framework tower is climbed.

Here, the climbing rail is placed on the lower working platform. Height-displaced roller bearings guide the inner-positioned framework tower on the building.

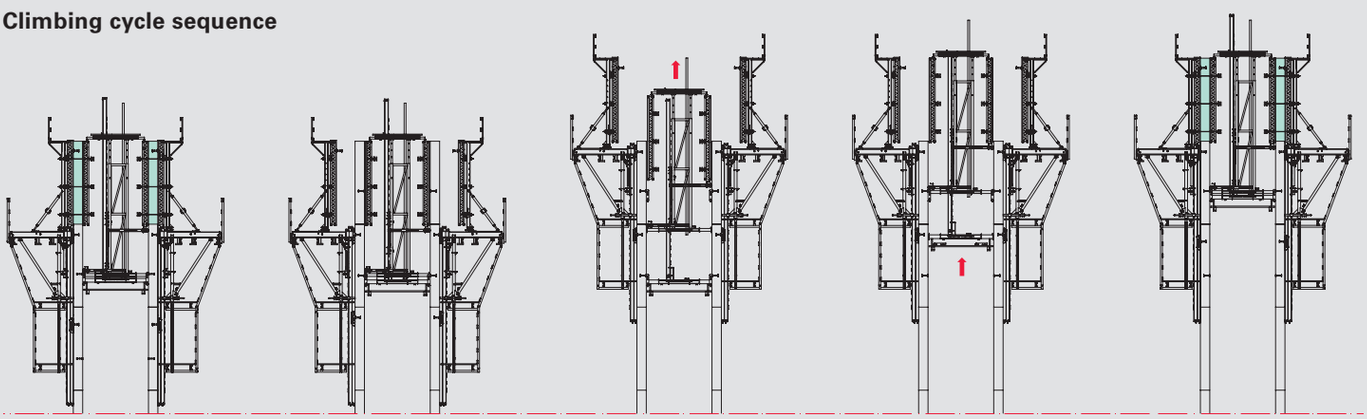
The lower working platform is subsequently pulled upwards with the climbing rail.

The top working platform is used for reinforcing and concreting; the wall formwork is suspended on this.
During climbing, the formwork moves away from the wall only a fraction. This means the available working area for tending the formwork is not reduced in any way.

Alternatively, the external formwork can also be suspended from the top platform when constructing smaller shafts. With larger shafts, several ACS S units can be combined side by side.

Project: Leura Apartment Building, Sydney, Australia.

Climbing cycle sequence



1st Step
Walls shuttered and concreted,
Position and secure leading anchor

2nd Step
Remove leading anchor fixing,
Strike, Climb external formwork

3rd Step
Climb internal formwork up to leading anchor,
Attach mounting shoe,
Continue climbing,
Lower framework tower on mounting shoe

4th Step
Remove bottom anchorage,
Pull up working platform,
and place on mounting shoe

5th Step
Position internal formwork,
Reinforce, Close formwork,
Concrete

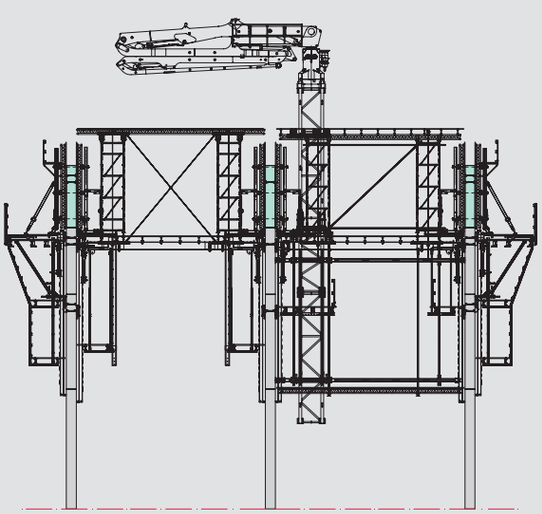
System Combinations
ACS versions work smoothly and problem-free with each other

PERI engineers find the most rational solution for any task and any building shape.

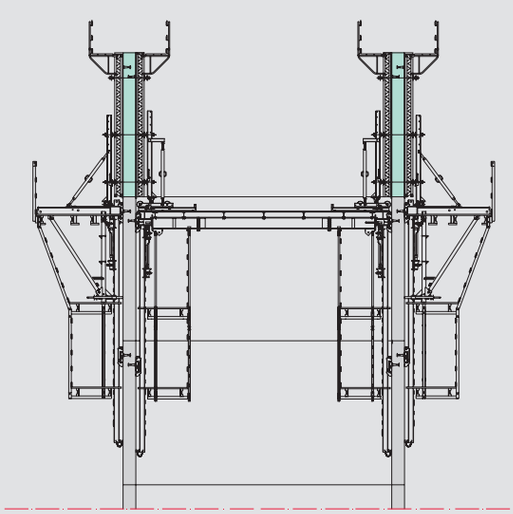
Regardless which one of the different ACS versions is selected, an optimized and cost-effective solution is always created for each particular structure. The individual systems are easily combinable and can be extended by means of additional customised components.

World Port Center, Rotterdam, Netherlands:
A total of 25 cleverly combined ACS units (21 ACS R, 3 ACS P and 1 ACS G) provided cost-effective 5-day concreting cycles for the construction of the standard floors.

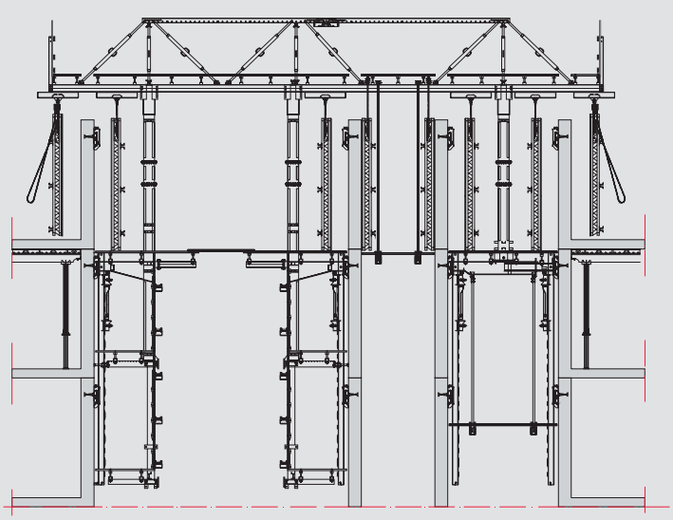
Photo (right):
Gallileo Highrise Complex, Frankfurt, Germany: ACS R, G and P on the cores; climbing protection panel ensured safe working conditions for site personnel on the upper storeys with no gaps and open edges.



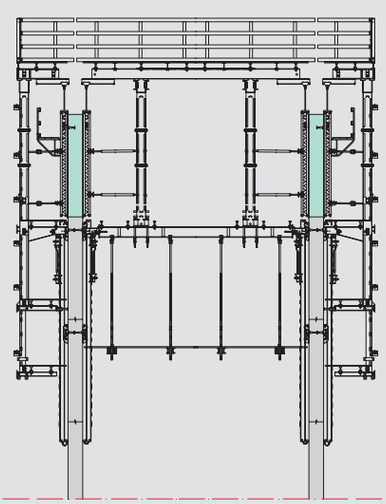
ACS P as internal platform with additional working platforms on ST 100 Stacking Towers above the formwork, combined with ACS R as external formwork.



ACS P and **ACS R** without the top working platforms above the formwork.



ACS G and **P** combined with a framework superstructure on which the complete movable formwork is suspended.



ACS G and **P** combined - the uppermost working areas are together on one level.

Project-related solutions with ACS

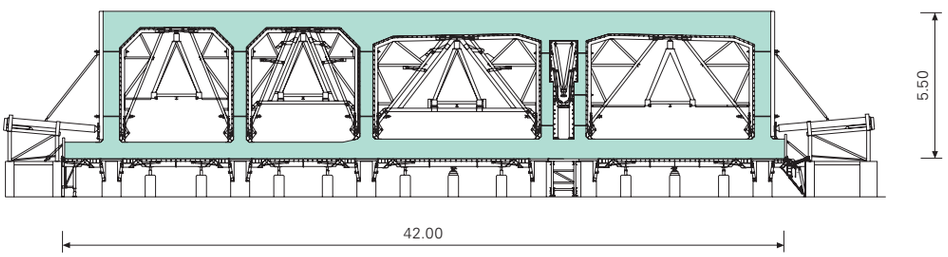
Versatile use of the proven ACS climbing technology

For numerous requirements related to the moving of complete formwork units and scaffold units, reliable and safe advancing equipment is used.

These modified versions of the PERI ACS climbing principle are used in bridge and tunnel construction. With their help, moving procedures on horizontal as well as inclined levels can be safely and efficiently designed.

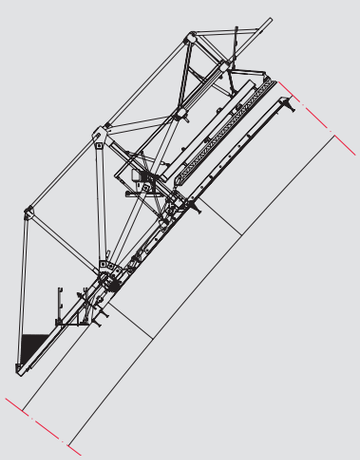
Project
Tunnel Oeresund
from Denmark to Sweden

Stationary production facility for monolithic tunnel segments. A climbing device version, with 200 kN compressive force, hydraulically moved transporter beams and formwork units.



Ponte Santa Lucia, Italy

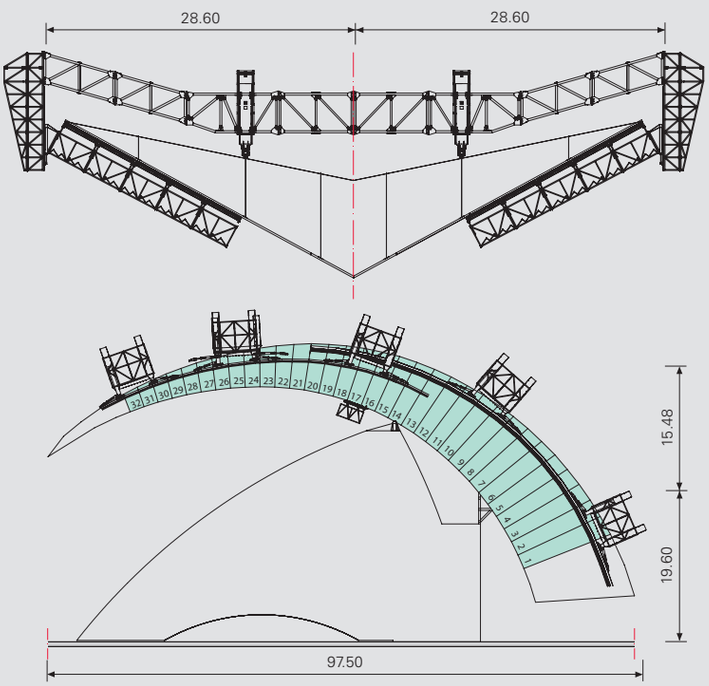
Hydraulically movable fomwork carriage for concreting the bridge arch. During the construction, the climbing scaffold and formwork are adapted to the form of the arch with ACS R system from cycle to cycle.



Section of the climbing scaffold with retracted formwork and climbing device.

Opera House, Santa Cruz, Tenerife, Spain

Hydraulically-operated and thus crane-independent movable formwork unit for the construction of a 100 m long self-supporting reinforced concrete roof.



Cross-section of formwork carriage with moving and adjustment equipment.

The formwork was used continuously for 32 casting segments in regular weekly cycles - only two breaks were needed because of formwork element adjustment.

The spectacular structure was designed by the architect Santiago Calatrava and cost-effectively constructed with PERI technology despite the difficult component geometry.

RCS Rail Climbing System

Modular construction system for a wide range of applications in climbing technology

The PERI RCS climbing system combines the advantages of different climbing systems in one modular system.

Depending on the requirements and use, the system can be climbed with the crane or raised by means of mobile, hydraulic climbing devices. The RCS modular construction system allows standard solutions to be easily adapted to project-specific requirements.

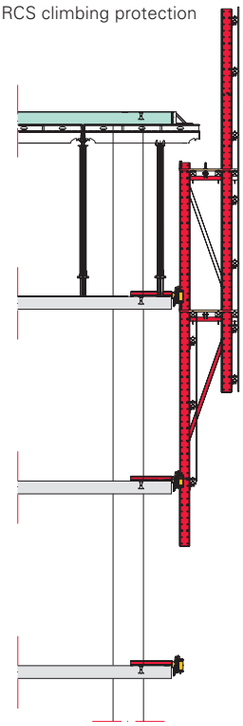
RCS Climbing Protection Panel

for completely enclosing floors under construction particularly those in high skeleton structures.

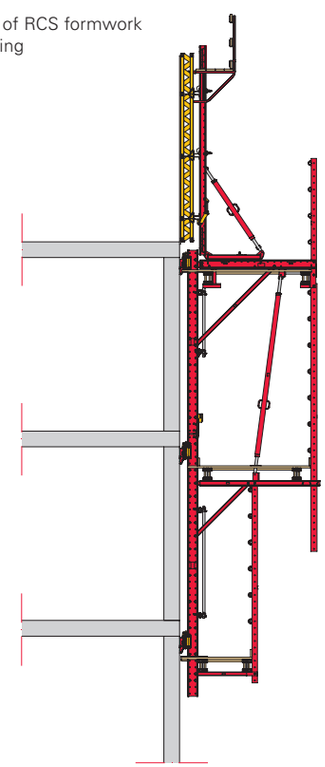
RCS Formwork Scaffolding

for rail-guided climbing of wall formwork.

Section of a RCS climbing protection panel



Section of RCS formwork scaffolding



Both systems, the climbing protection panel and formwork scaffolding, can also be climbed hydraulically and are thus crane-independent.

With the mobile self-climbing devices and hydraulic pumps, the cost of the self-climbing technology is reduced as well as ensuring cost-effective implementation for structures with lower heights.

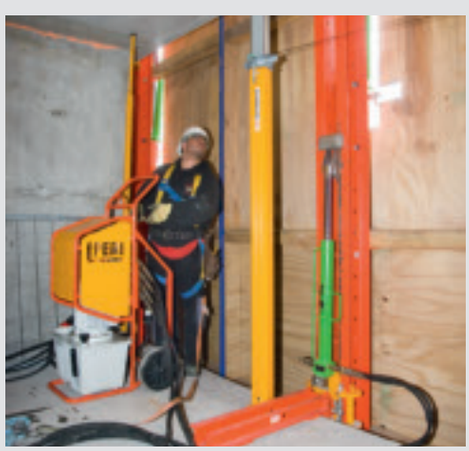
The hydraulic pump and cylinder are quickly operational.

Safer and faster through a guided climbing process:
With the climbing rail, the scaffold unit is always connected to the building by means of the climbing shoe for the entire climbing procedure. Moreover, it is impossible for the RCS climbing unit to "drift" during strong winds. This means that climbing can take place safely and quickly at any time.

The hydraulic cylinder, with 5 t lifting capacity, can be easily positioned on the climbing shoe and rail.

Advantages:

- The climbing rail is not climbed in advance but, instead, is part of the load-bearing system.
- Wall openings are easily bridged by the climbing rail.
- The mobile self-climbing equipment can be retrofitted at any time.



PERI RCS Formwork Scaffolding
Rail-guided climbing of wall formwork

For use as formwork scaffold, floor heights from 2.70 to 4.50 m are possible.

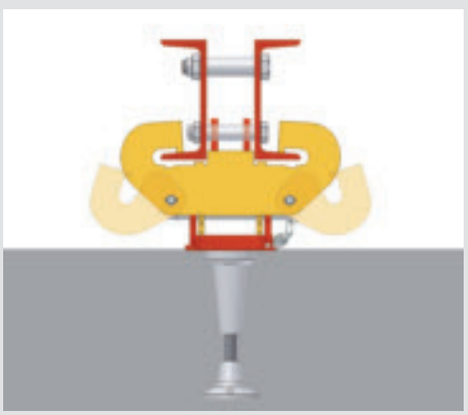
Adaption takes place through the combination of four RCS climbing rails of different lengths. The 125 mm hole arrangement on the climbing rails allows platform adjustment to match the floor heights of the building. During the moving process, this guarantees safe and almost continuous transition to those platforms not yet climbed.

The static system consists of two bracket units arranged on top of each other which are connnected by a hinge in the climbing rail and a spindle. Thus, the construction is adjustable so that climbing can be carried out even over wall breaks.

Side and end protection can be formed using simple guardrail boards, scaffold tubes or by being completely enclosed.

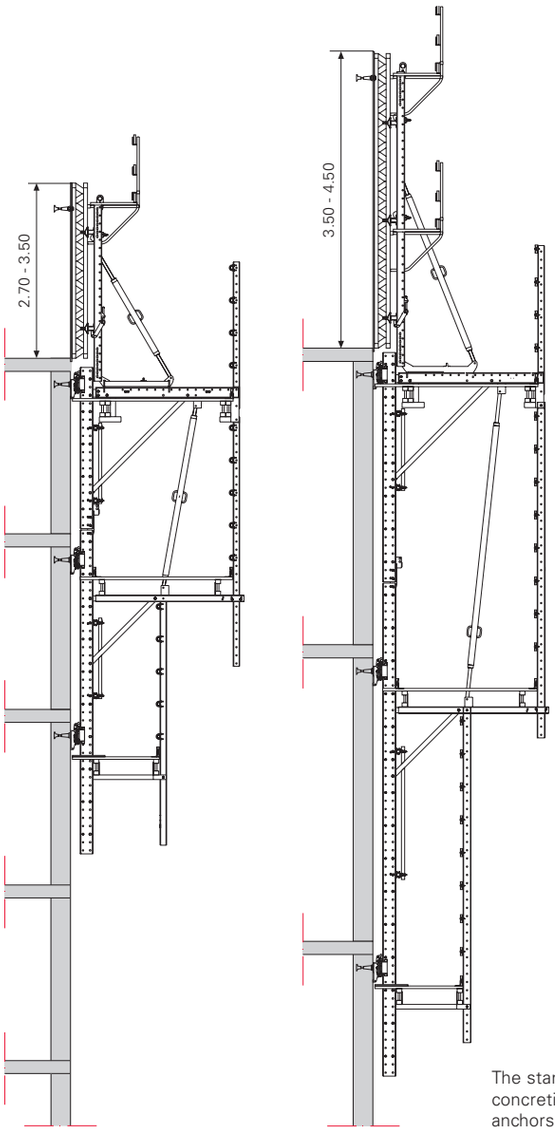
Formwork scaffold construction with gap-free guardrail protection using scaffold tubes. Increased safety levels are provided by the 2.00 m high guardrail on the main working platform.

The PERI RCS climbing shoe guides the climbing rail during the moving process to the next concreting section. For wall offsets, vertical climbing inclinations of up to 4° can be compensated through the hinged bearing. The integrated climbing pawl automatically engages the connection bolts of the climbing rail and secures the unit at a distance of 50 cm. Already on the first concreting section, the upper part of the formwork scaffold is easily mounted to the foldable runners of the climbing shoe.



Safe and efficient moving procedure with the RCS climbing shoe

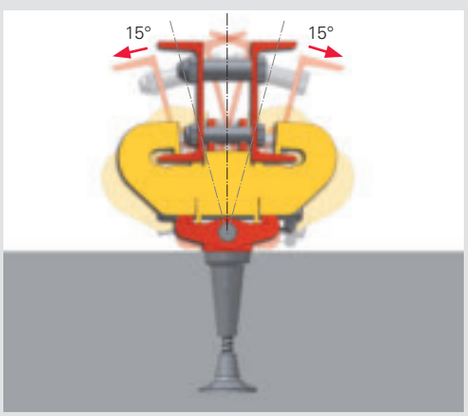
Foldable runners allow the lateral dismantling of the climbing shoe and simplify the initial assembly.



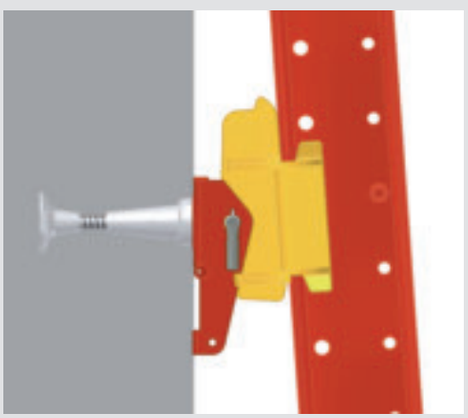
The standard assembly of the formwork scaffold allows concreting heights of up to 4.50 m without intermediate anchors.

Carriage RCS

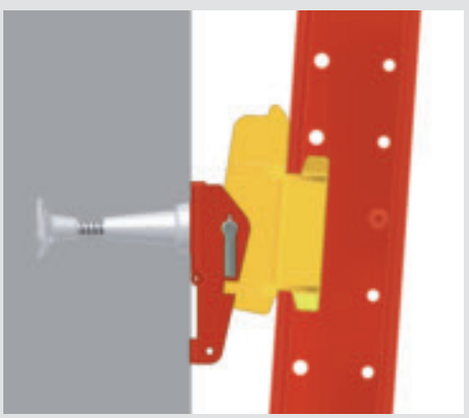
The formwork is firmly mounted on the carriage and can be retracted by 90 cm without the use of a crane. The carriage itself has a self-locking bevel-gear drive and is easy to operate without any jerking through the roller bearings. For supporting the formwork on the carriage, an SRU steel waler serves as a strongback and an SLS heavy-duty spindle as an adjustable strut.



With the hinged wall shoe, the RCS can be used on circular structures. Brackets and carriage are arranged in parallel positions.



RCS climbing rail in a 4° forward angle position.



RCS climbing rail in a 4° reverse angle position.

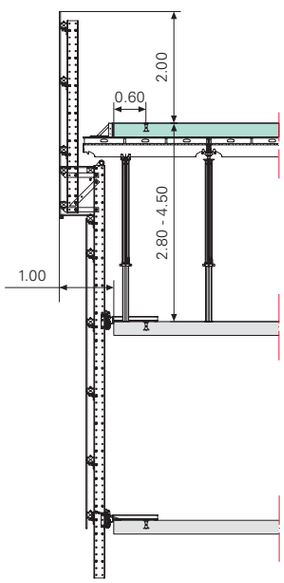
PERI RCS Climbing Protection Panel

Enclosure and fall protection for high buildings

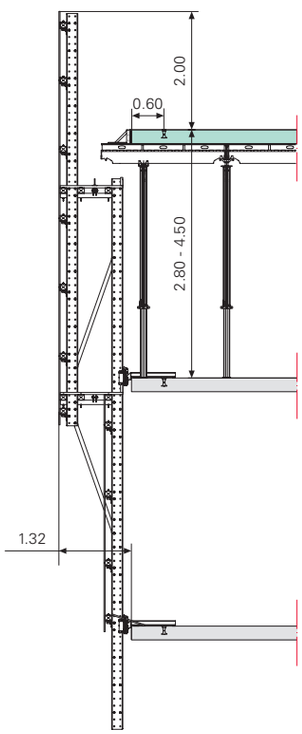
With the RCS climbing protection panel, the slab edges on the upper floors are completely enclosed. Site personnel are secure against falling at all times and protected against strong winds when working at great heights.

Anchoring to the building is carried out by means of slab shoes together with system climbing shoes which guide the panel up the building during the climbing process. A fast and safe moving procedure is ensured in any weather through the rail-guided climbing.

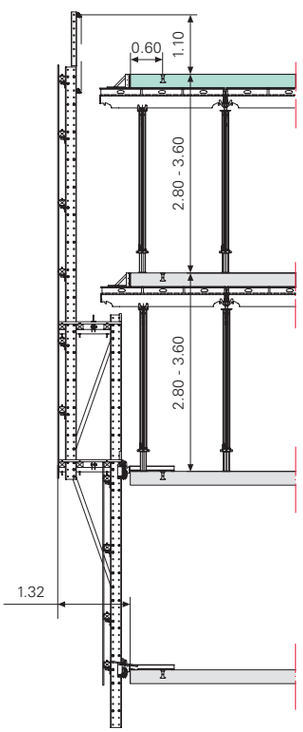
A further positive side-effect is the advertising area available on the outside area. The RCS climbing protection panel can also be tailored to suit the requirements of the contractor.



Small platform widths for easy assembly to the outer facade.



Wide platforms for slab pre-tensioning for storey heights from 2.80 - 4.50 m.

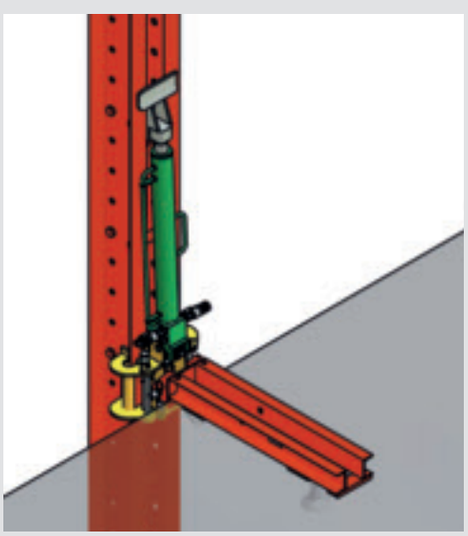


High projecting enclosure shield for covering two floors in advance.

The climbing protection panel provides safe and efficient working conditions - even at great heights.

The outside surface of the climbing protection panel can be effectively used for advertising purposes.

Through the enclosure, a covered working area is formed which provides protection from wind and weather as well as significantly raising work productivity of the construction crews due to the increased feeling of safety.



Depending on the geometry of the building and requirements, the RCS climbing device can be installed either on the walls or slabs. In both cases, the mobile climbing hydraulics can be used to allow crane-independent moving of the units.

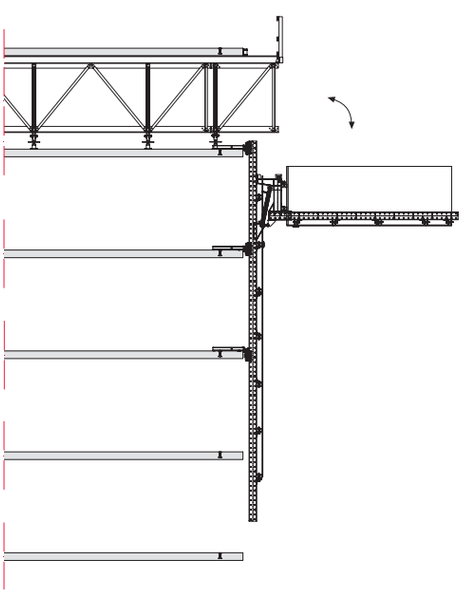
Drawing:
RCS climbing device, anchoring to the slab

Project-related solutions with RCS

The modular system for minimizing the number of special parts

With project-specific solutions, the specialist immediately thinks of the need for special parts which are then written off when the job is finished. This is not the case with PERI RCS. The modular construction system reduces the use of special components to a minimum.

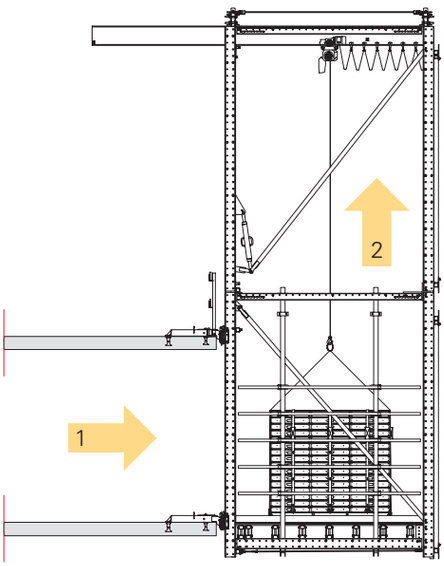
In close cooperation with the contractors, PERI engineers develop rational solutions - including those for the formwork logistics. This can be cost-effectively realised through the high proportion of rental parts also for buildings with lower heights.



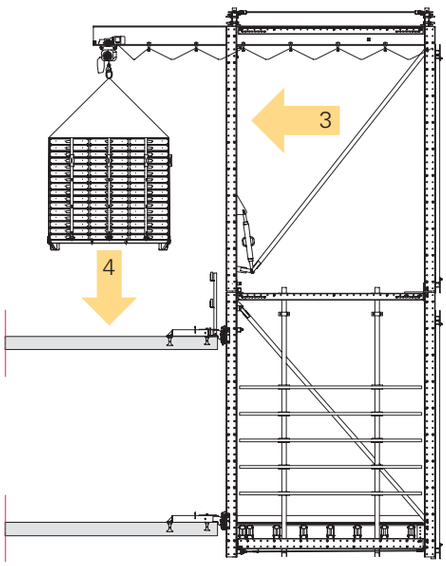
Hydraulic hinged units of the climbing protection panel for extending large-area slab tables such as the PERI SKYTABLE.

Concord City Place, Block 24 LM
Toronto, Canada

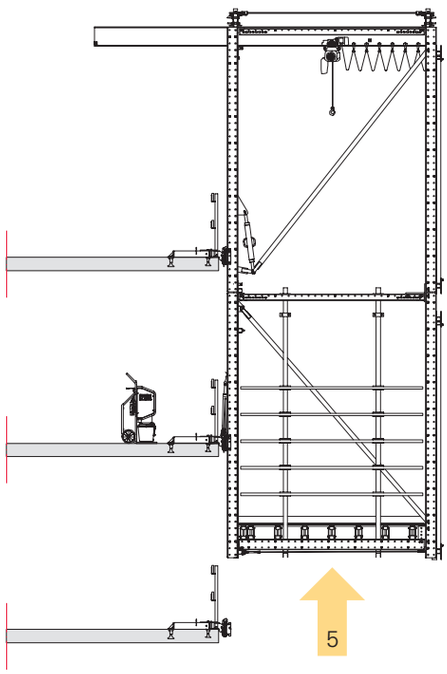
Formwork Lift RCS



Start operations



Moving



Climbing

Another step in the direction of a crane-independent construction site:
Formwork Lift RCS for transporting slab formwork, e.g. PERI SKYDECK, without a crane.

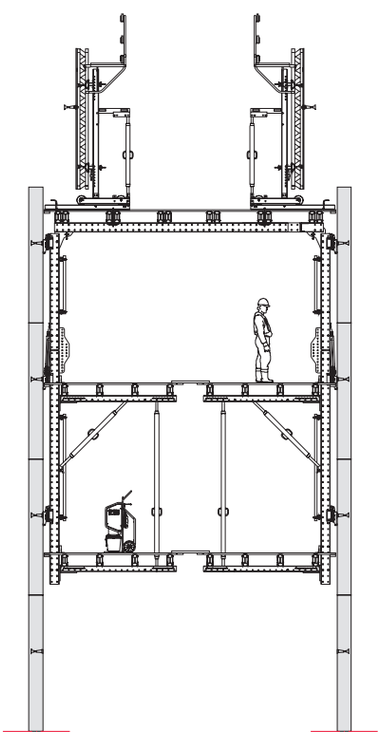
The formwork lift can be moved to the next floor either with the crane or by using the mobile climbing hydraulics. It is also optionally available in a wider design for transporting slab tables.

Landing platforms consisting of standard components for moving the slab formwork.

Ritz Carlton Hotel
Philadelphia, USA

RCS shaft solution: as a platform beam, the RCS climbing rail can be continuously telescoped.

The Landmark,
London, Great Britain



RCS shaft solution

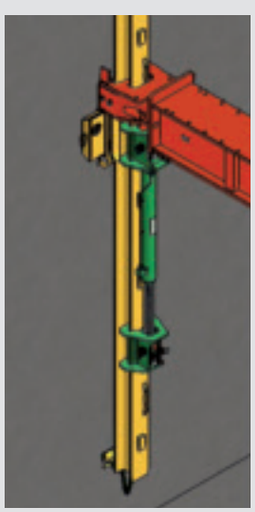
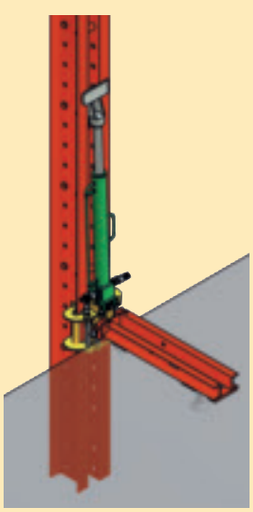
ACS and RCS Self-Climbing Systems
Comparison

Bellevue Towers, Seattle, USA
ACS P and G versions for the core, RCS climbing protection panel on the facade.

Kinsey Station, Chicago, USA
Massive perforated facade with ACS R.

Bankside 123, London, Great Britain
RCS Formwork Scaffolding on the building´s core.

	PERI ACS	PERI RCS
Standard versions	■ ACS R formwork scaffolding with strongback and formwork carriage on brackets ■ ACS V formwork scaffolding with strongback and formwork carriage on adjustable brackets ■ ACS P formwork platform with suspended, movable formwork ■ ACS G formwork scaffolding with gallow-suspended movable formwork ■ ACS S formwork scaffolding for shafts with suspended formwork	■ RCS formwork scaffolding with strongback and formwork carriage on adjustable framework brackets ■ RCS climbing protection panel with framework frame as load-bearing system and enclosure panel on climbing rails ■ Project-specific solutions using RCS standard components: formwork scaffolding with gallows, formwork lift, extendable platforms, shaft platforms, climbing strongbacks
Areas of application	ACS Formwork Scaffolding for ■ External and internal areas for highrise building cores, stairwell and elevator shafts ■ Highrise building facades ■ high, strongly-inclined bridge piers and pylons ■ Towers and chimneys	RCS Formwork Scaffolding for ■ External sides of highrise building cores, stairwell and elevator shafts ■ Highrise building facades ■ Bridge piers and pylons ■ Towers and chimneys ■ Climbing protection panel for skeleton structures
Typical decision criteria	■ Very large building height from approx. 20 floors upwards ■ Large-area facade with space for large platforms ■ Large bracket spacing with few tie points ■ Climbing complete core structures ■ Complicated building ground plans ■ Higher labour costs	■ Medium-height buildings: crane-assisted climbing up to approx. 15 floors, self-climbing as of approx. 10 floors ■ Facades with recesses and short wall sections ■ Different versions with the same components ■ For thin walls due to less bearing load ■ Moderate labour costs

	PERI ACS	PERI RCS
Climbing methods	■ Rail-guided self-climbing Climbing Rail HEB 160 climbs in advance, is automatically secured in the Climbing Shoe ACS and carries the system whilst in a climbing mode.	■ Rail-guided, crane-assisted or self-climbing Climbing Rail UU 200 is a component of the support structure and is to be inserted into the advancing climbing shoe for the climbing procedure.
Climbing device	■ ACS 100 lifting capacity 10 t ■ Stroke length 64 cm (effective) ■ Lifting speed 0.5 m/min ■ Self-actuating force control	■ RCS 50 lifting capacity 5 t ■ Stroke length 50 cm (effective) ■ Lifting speed 1.0 m/min. ■ Self-actuating spring mechanism
Hydraulics	■ 2, 4, 6 and 8-fold hydraulic pumps ■ 400V/50 Hz or 460V/60Hz with electronic control ■ Climbing groups with up to 4 platforms can be climbed simultaneously with an 8-fold pump assembly ■ Complete hydraulic system is firmly installed on the scaffolding ■ Extremely reliable and robust control system and mechanics	■ Mobile 4-fold hydraulic pumps ■ Variable, 380-460V/50-60 Hz with mechanical control system ■ One or two platforms climb simultaneously ■ Mobile climbing device, pumps and hoses. Movable by hand ■ Minimization of the hydraulics, thus very cost-effective
		
	ACS climbing device being used in the ACS P version.	RCS climbing device for use in the RCS climbing protection panel.

Petronas Towers
Kuala Lumpur, Malaysia

The complicated atypical first floors were each quickly completed in five to six days. For the standard floors, a 3-day cycle was achieved within a very short space of time. This cycle had to be extended to five days due to subsequent building components having to be taken into account.

Contractor
MAYJAUS Joint Venture
(Malayan / Japanese / American Consortium):
MMCE, Hohup, Hazama, J.A. Jones and Mitsubishi.
Field Service
PERI Hory Malaysia, Kuala Lumpur
PERI Weissenhorn

The Petronas Towers, as part of the Kuala Lumpur city centre, was the highest building in the world until the completion of the 101 structure in Taipeh, Taiwan in 2004.

With a diameter of 50 m respectively, the twin towers reach an impressive height of 452 m.

The contractors the MAYJAUS consortium, decided on the PERI ACS self climbing formwork due to three main reasons:

Safety
ACS is designed for wind speeds up to 180 km/h. Even during winds of 80 km/h, it is still possible to work safely and to climb. This is particularly important in Malaysia because hurricane force winds are often recorded during the monsoon season. Furthermore, it is also necessary to store heavy loads on the platforms as well as ensuring that the formwork is connected safely to the building at all times when climbing, shuttering and striking.

Speed
Through the large lifting capacity per hydraulic cylinder (100 kN), the PERI ACS allows fast concreting cycle times. The ACS does not require any crane assistance for raising the formwork. Site cranes can be used exclusively for moving materials and reinforcement.

Reliability
Another decisive factor at the time of construction was PERI´s 20 years of experience in the field of climbing formwork. Added to this were references from numerous high structures already completed along with the company´s leading position in technically sophisticated self-climbing technology.

Petronas Towers
Kuala Lumpur, Malaysia

14 external and 10 internal formwork units were used for the 23 x 23 m large building core. These could be climbed independently of each other according to the required construction sequence.

For the construction of the 88 usable floors, a total of around 160,000 m³ of high-strength concrete were used in forming operations.

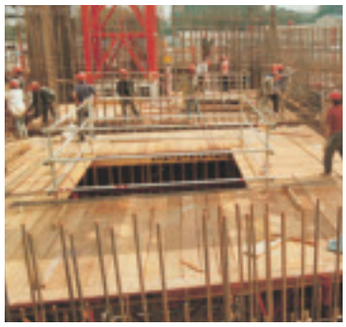
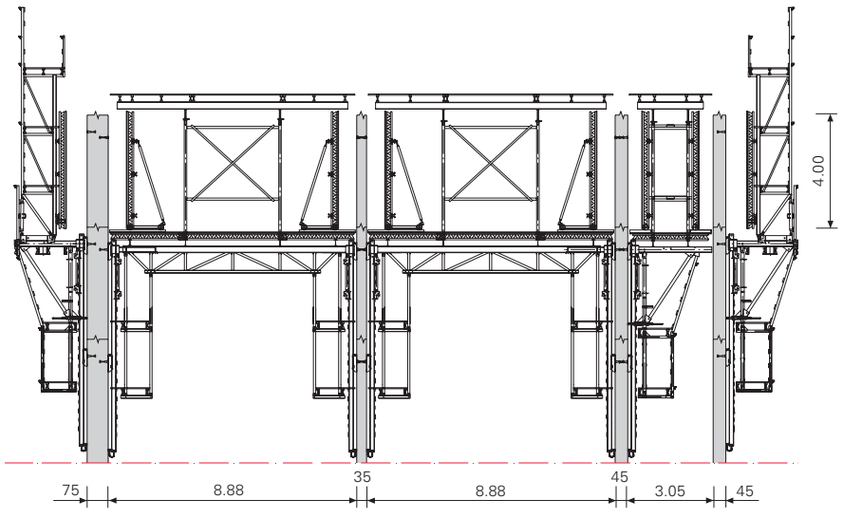


Photo (top): two of the three longitudinal external formwork units have already been raised and are now in position for the next cycle.

Photo (bottom): internal working platform for reinforcing and concreting.



The complete formwork, with six working platforms, climbs the core of the building without the need of cranes. Between the core walls, large-area working platforms are available which are crane-independently climbed together with the VARIO girder wall formwork units from floor to floor.

Edwin Foxworth (left)
and Tony Hickmott
Project managers of the MAYJAUS Joint Venture

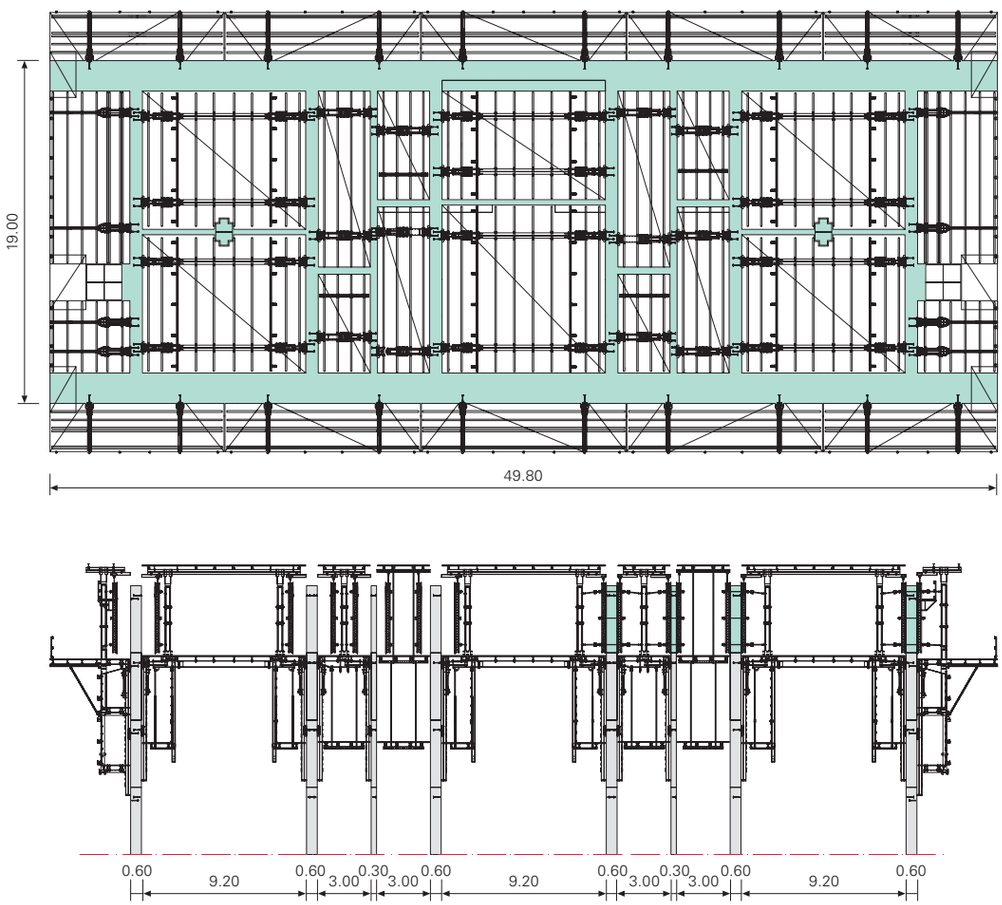
The Petronas Towers - two identical skyscrapers with a total height of 452 m after completion in 2005.

Imperia Tower
Moscow, Russia

With a combination of the ACS R, P and G versions in connection with the VARIO GT 24 girder wall formwork, PERI engineers put together a solid system package for the safe and rational construction of the 0.30 m, 0.60 m and 1.60 m thick core walls.The complete core layout measures 49.80 m x 19.00 m and is completely enclosed by working platforms and platforms, so that wall formwork operations as well as reinforcing and concreting can take place on secured, generously-sized areas.

The reinforced concrete core tapers in a longitudinal direction, above 22nd and 34th floors respectively as well as in a lateral direction from the 55th floor onwards. This was taken into consideration during the planning and organization of the ACS units in the form of mutually connected climbing groups. This meant that the time and expense involved for any modification work could be kept to a minimum.
14 ACS units on the outside were divided into six climbing groups, while the ten internal platforms could be operated via seven groups.

Thus, an alternating, staggered climbing procedure was possible in order to be able to carry out cleaning and reinforcement work more easily as well as faster. Being crane-independent along with the fact that using ACS meant site personnel could continue working even at wind speeds of up to 164 km/h, resulted in enormous time savings during the project. In the event, complete floors were able to be finished in regular five-day cycles.



Layout and standard section of the building core from the ground floor up to the 22nd storey.

With 10 ACS R and 4 ACS G units on the outside as well as 10 internal ACS P units, the 3.75 m high concreting sections could be safely constructed.

Atilim E. Kurt
Site Manager

"Through the technical support provided by the PERI supervisor and the simple assembly process, we could save time which benefitted us in maintaining the tight construction schedule."

Contractor
ENKA Insaat ve Sanayi A.S., Moscow
Field Service
PERI Moscow and PERI Weissenhorn

The use of the ACS system and VARIO, SRS circular column formwork, TRIO column formwork as well as PERI table modules was expertly synchronized to ensure construction progress was accelerated.

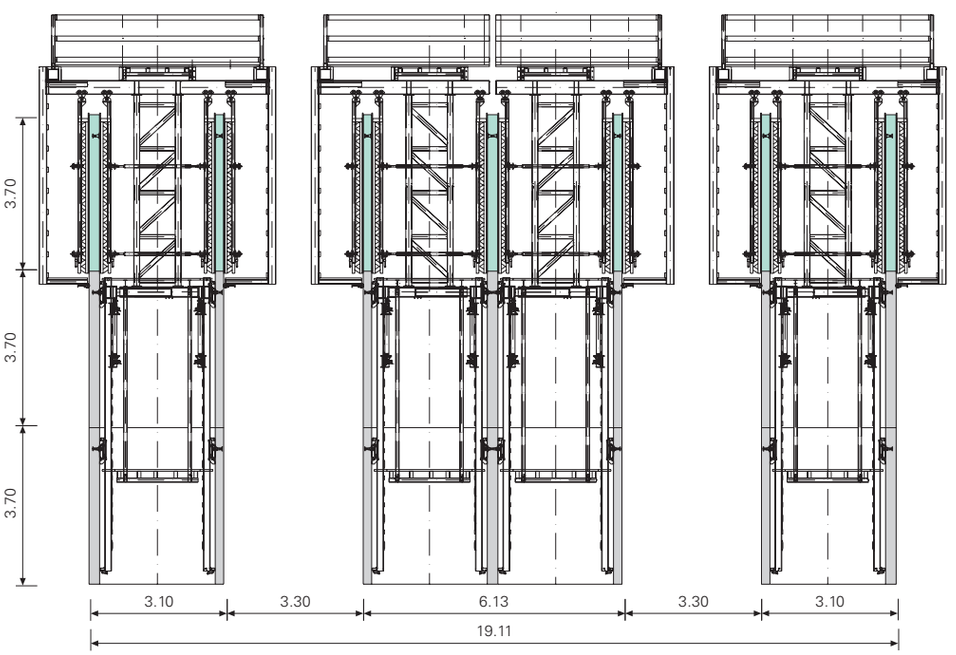
The 238 m high Imperia Tower is part of an ambitious construction project in the Russian capital. 15 impressive skyscrapers are being built in the international business centre in downtown Moscow, a mere four kilometres from the Kremlin. This means around 2.5 million square metres of office, residential, business and recreational areas will be developed directly on the banks of the Moskwa river over the next few years.

Headquarters of Türkiye IS bankasi
Istanbul, Turkey

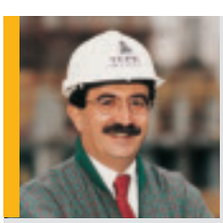
The business and trading centre of Istanbul is dominated by the construction of numerous new highrise buildings. As another landmark in the "City of Towers", the IS Bank invested in a three-part building complex whose main tower comprises 50 floors. With a height of 171 m, the skyscraper is the highest building in Turkey.

For this project, the crane-independent ACS self-climbing technology was used for the first time in Turkey. Construction crews formed 90 % of the slab areas with PD 8 slab tables which were easily adapted to suit floor heights varying from 3.00 to 9.00 m.

The main tower´s core was shuttered with VARIO and ACS, and climbed two levels in advance of the storeys.The columns were subsequently formed with VARIO column formwork and the slabs with MULTIFLEX and PD 8 tables.



ACS solution for medium-sized shafts: self-climbing internal platforms are connected to the framework and distribution grid. The internal and external formwork as well as the outer working platforms are then mounted on them. The gallows section is equipped with a carriage with rollers, on which the formwork is positioned. The assembly is climbed as a complete unit by means of the ACS hydraulics. Climbing is controlled and monitored from the inner-positioned finishing platform.



Haluk Tazebay
Project Manager

"PERI is the only partner in Turkey capable of providing a cost-effective answer to all of the formwork-related problems as well as offering a comprehensive technical service during the construction period. We decided in favour of the ACS system because we wanted to reduce crane capacity along with being able to work safely at high wind speeds."

Contractor
TEPE INSAAT SANAYI A.S.,
TURNER STEINER INT. S.A.,
ORTAK GIRISIMI
Field Service
PERI Istanbul, Turkey
PERI Weissenhorn, Germany


CREDIT LYONNAIS

Tour PB 6
La Défense, Paris, France

For the construction of the 160 m high office and administration building in the "La Défense" highrise district of Paris, the contractor was faced with a considerable challenge in terms of formwork, safety and logistics due to the restricted space available and tight building schedule.

The elliptical core, with twelve crosswalls and ten intermediate walls, was divided into four construction phases.

21 internal shafts as well as ten external units, with a total formwork area of 1,502 m², had to be climbed in sections or together depending on the construction progress.

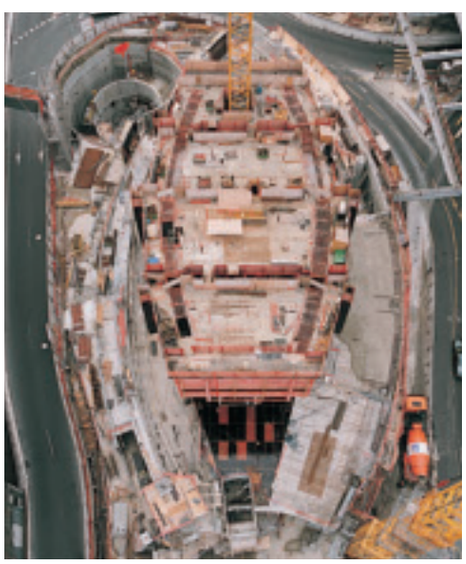
Marc Guerpin
Site Manager

"In spite of the complicated building geometry, we could finish one storey every four days. Without a crane, we used 1,500 m² of wall formwork above the level of the slab. The horizontal concreting work could be carried out separately from the walls, resulting in an acceleration of the construction schedule."

The PERI solution: ten ACS G units with a maximum length of 11.30 m were used on the outside. They also had to accommodate changes in wall thicknesses from 1.20 to 0.60 m and 1.00 to 0.40 m. Wall breaks of 20 cm respectively could easily be bridged by using standard system components and adapters. The modular ACS P system was used on the internal areas. Each of the units climbed with six or eight climbing devices.

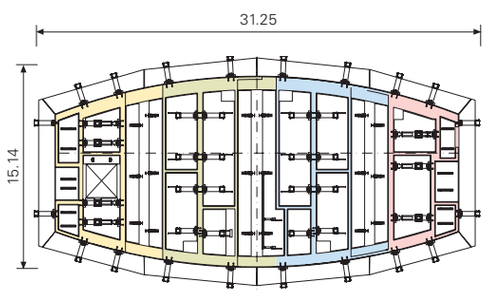
The 1,114 m² formwork elements consisted of standard VARIO GT 24 and SRZ system components, whereby work was carried out usually with two tie levels per 3.55 m concreting height. 21 mm Fin-Ply birch plywood was used as the formlining.

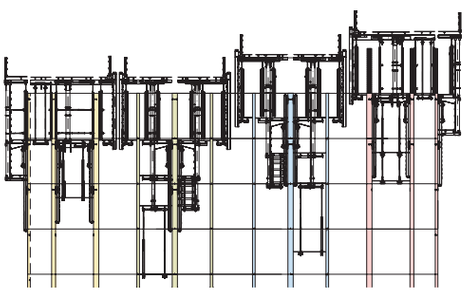
For the internal shafts in the crane and stairwell areas, 389 m² of steel formwork with 4 mm thick plating was used due to reasons of space.
Not only could all working levels, internal shafts and external elements be accessed via separate ladders, but the crossover between sections on Levels 0 and 1 was also possible during all phases of the work.



Extremely cramped conditions required just-in-time element deliveries.

The Tour PB 6 is one of the highest buildings in the La Défense district of Paris.





Zone 4 Concreting | Zone 3 Striking | Zone 2 Climbing | Zone 1 Reinforcement/ Forming

Trump World Tower III
The skyscraper has re-defined the New York skyline through its height of 258 m complete with its luxurious interior furnishings. With restaurants, 24-hour concierge service, reception and security personnel, room service etc., the highest residential building in the world offers an opulent ambience at the highest possible level.


MetLife

Trump World Tower III
New York, USA

The layout of this impressive skyscraper is divided into three sections by two main load-bearing walls. Three shafts are positioned on the southern wall. On the lower levels, the facade consists of 27 columns. However, their cross-sections, positions and number change on the way up. The standard storey height is 3.25 m whereby the formwork was designed for the maximum concreting height of 3.86 m.

The building contractor followed a common practice for this part of the world: the facade columns, main load-bearing walls and shafts were formed together with the slabs. The columns were concreted first, then the walls and shafts, followed by the slab.
22 of the 27 columns in the facade were formed using PERI materials as the rest of the area served to provide access for the crane in order to lift the slab and wall formwork to the next storey. Five hydraulic pumps were used to raise the twelve ACS R units on the facade. A separate hydraulic pump was available for each of the three shafts. Due to the narrow shaft widths of 2.36 m, ACS G brackets were used which were suspended on the VARIO elements inside the shafts.

With a workforce of 187, the contractors achieved a three-day cycle for the construction of a complete storey. In the standard floors from the 22nd floor onwards, a two-day cycle was achieved.

Contractor
North Berry Concrete
Field Service
PERI Weissenhorn and USA, New York

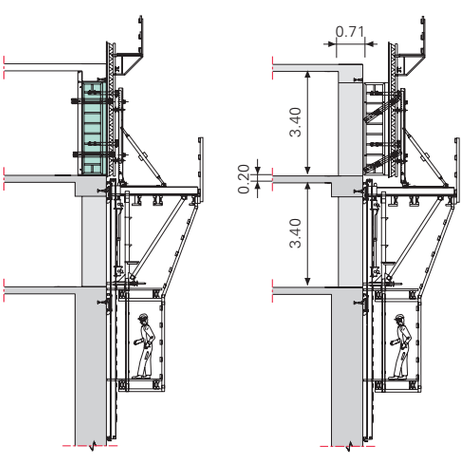
Reinforcement crew working on the upper floor layer. In the background: the gallows of the ACS G on which the inner formwork of the core walls is suspended.

All platform levels are completely enclosed so that the personnel can work safely, secured against falling.

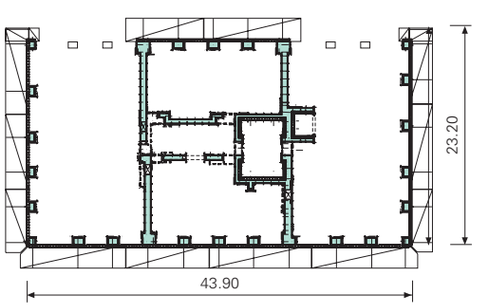
Tom Henry
Superintendent

"There are many good reasons for deciding on PERI ACS. The high degree of safety and the fact that the continually overworked crane is not needed for the self-climbing system are to be named among these."

Building layout: shuttered facade columns and inside walls.

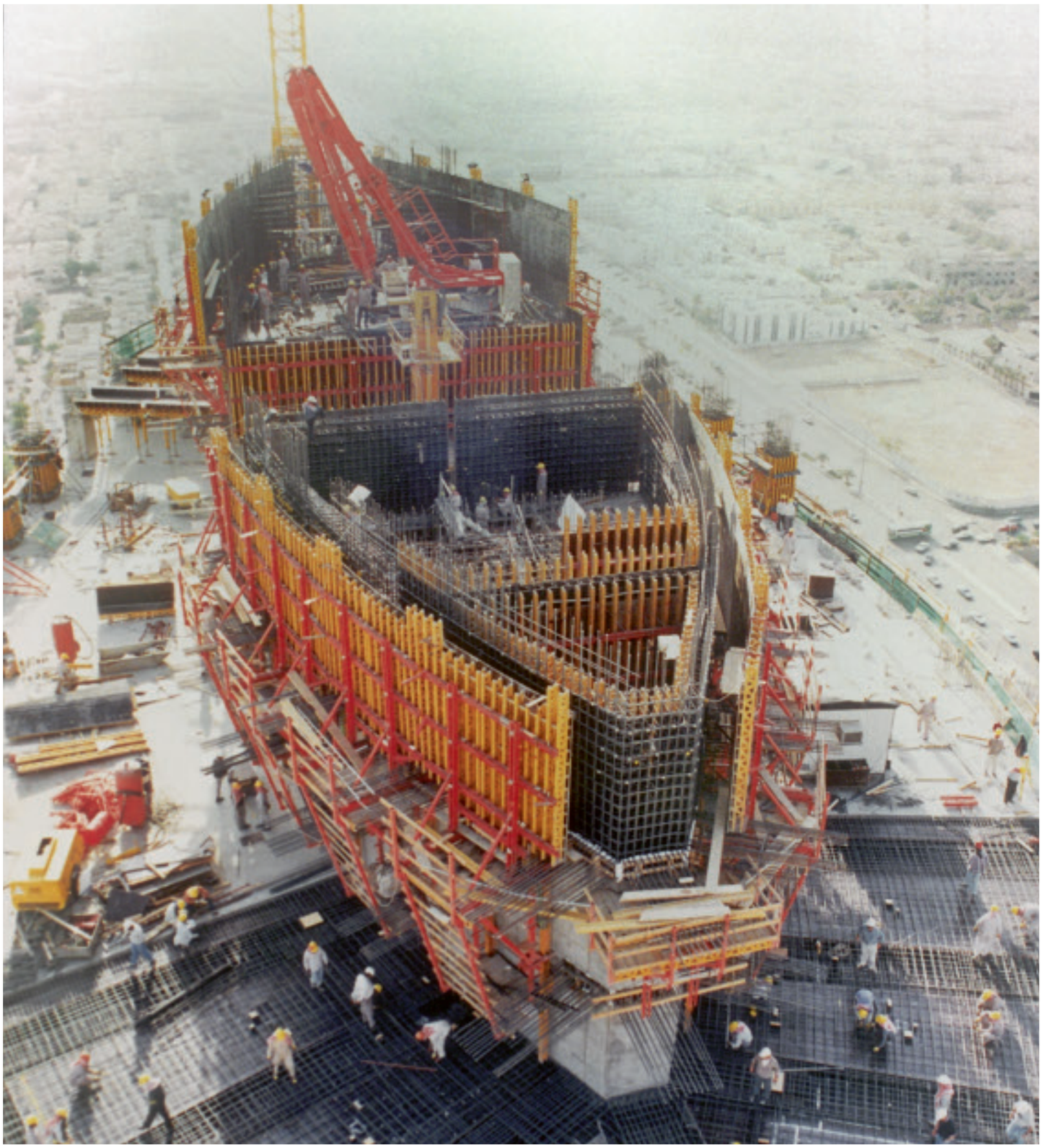


The column formwork climbed crane-independently: TRIO side elements were pivot-mounted to the end-to-end VARIO girder wall formwork and could be adjusted to suit the changes in the column widths. Climbing from cycle to cycle was carried out using the ACS R unit.



The finished Trump World Tower on the United Nations Square is the worldwide largest and most exclusive residential building project for the new century.

Kingdom Trade Centre
Riyadh, Saudi Arabia

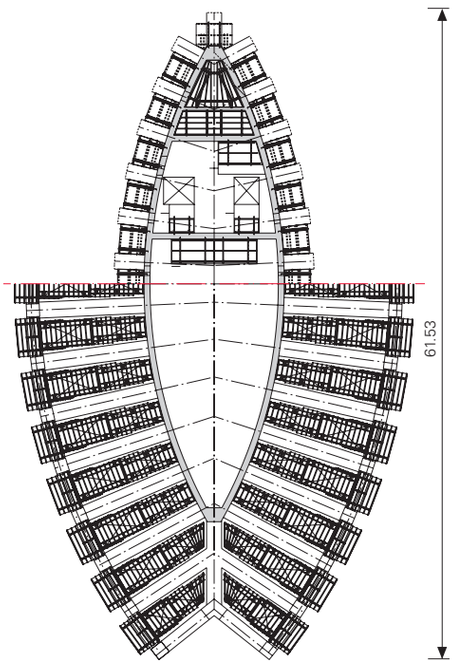


With a total height of 300 m, this new skyscraper in the centre of Riyadh would be one of the tallest building in Saudi Arabia. For the client, it was clear that the available crane capacity would be the decisive factor for this difficult project, and that a successful completion of the project would be dependent on the formwork concept.

PERI presented a combination of two climbing systems on the 34-storey core which reduced the available crane capacity and, at the same time, kept the budget for the whole formwork costs within reason: 432 m² of VARIO wall formwork climbed independently of the crane on 22 ACS R platforms on the outside of the core. The internal walls were formed with VARIO on CB 240 brackets. Here, formwork and climbing scaffold formed single units which could be moved by the crane, thus saving time.

In the area of the following floors, two UNIPORTAL table sizes (5.00 x 3.00 m and 5.40 x 2.70 m) along with project-optimized beam tables (principally 3.30 x 2.10 m) rounded off the cost-effective total concept. In regular four-day cycles, site crews could therefore complete construction floor by floor without any problems.

The core advanced ahead of the following slabs by two levels.



With 60 slab and 88 beam tables, around 1,660 m² of floor area was formed each time.

Contractor
El Seif Engineering Contracting Est, Riyadh
Field Service
PERI United Arab Emirates, Dubai

Photo (left): VARIO on ACS R on the external core wall. After removing the internal formwork, the outer ACS units are climbed hydraulically to the next cycle. At the same time, VARIO served as perimeter formwork for concreting the slabs.

The Kingdom Trade Centre is a superbly designed structure in the capital of Saudi Arabia, and a skyscraper in the true sense of the word.

Alberto Duronio
Construction Manager

"With ACS, we could dramatically reduce the problem of crane times on this gigantic construction site. Working with the self-climbing formwork is very easy, safe and accurate."

Park Tower
Chicago, USA

Contractor
James McHugh Construction Co., Chicago
Field Service
PERI Chicago und Weissenhorn

For the Park Tower Project on the North Michigan Avenue, PERI was commissioned to supply the formwork for foundations, retaining walls, props, walls and slabs.

A hotel complex was to be built within a very short construction period comprising of 70 floors, 205 rooms and 122 apartments. For a total of around 70,000 m² useable floor space, 36,000 m³ of concrete along with 4,000 tons of reinforcement had to be installed. The main contractor had a very clear idea of the construction sequence. The requirement was to construct two complete floors each week. In order to achieve this, the concreting of the slabs and walls had to be done in one pour. PERI engineers fulfilled this requirement and provided a tailor-made formwork solution.

In addition, the loads of the placing boom had to be accommodated by the ACS platforms. The ACS system was able to safely carry the high dead load of 3.5 t and climbed together with the placing boom from cycle to cycle.

For the slabs, the use of the SKYDECK aluminium panel slab formwork in connection with MULTIPROP post shores proved to be especially advantageous. The aluminium components of this system are very light. The heaviest element, the main beam SLT 225, weighs only 15.4 kg which allowed fast and less tiring work for the construction crews. With SKYDECK, the floor slabs could be quickly and easily shuttered by hand - without requiring the use of the crane.

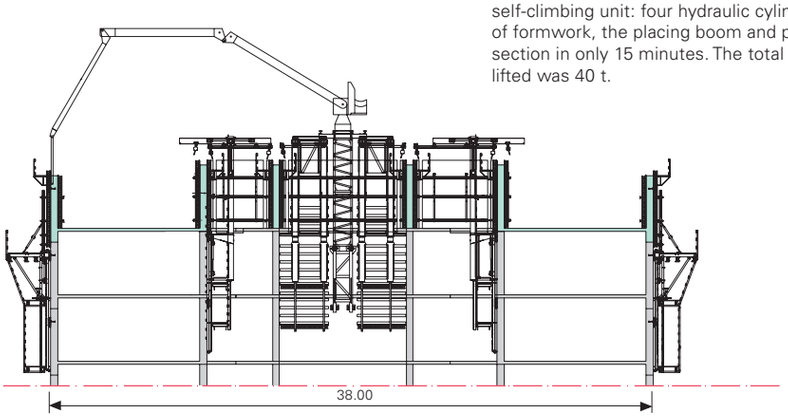
Paul Treacy
Project Superintendent

"The ACS system is really fast, reliable and safe. PERI engineering proved to be perfect and the support provided by the supervisor was first-class."

Adapting the ACS climbing units to the non-linear shape of the east side of the building involved a minimum amount of modification and without any additional crane support.

The internal wall formwork could be quickly and safely brought into position using chain blocks.

The placing boom climbed together with the complete self-climbing unit: four hydraulic cylinders move 200 m² of formwork, the placing boom and platform to the next section in only 15 minutes. The total weight of the unit lifted was 40 t.



The Park Tower grew by two complete floors each week. The total height of the finished project is 290 m.

New Office Extension for Bank
Pforzheim, Germany

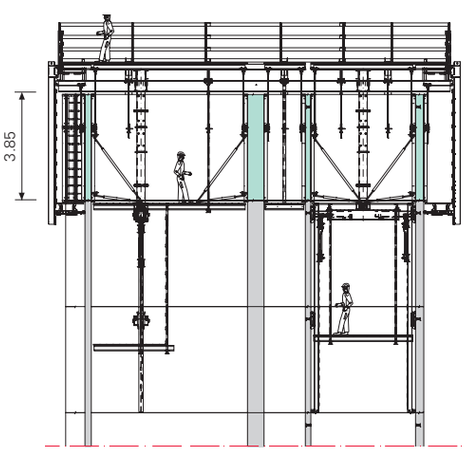
The office tower, a circular steel structure with a diameter of 22.60 m, is stiffened structurally by a 7.12 x 13 m core containing the elevator shafts and a stairwell.

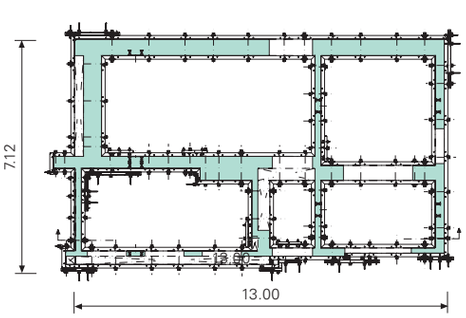
Due to the short construction schedule, this necessitated the use of a crane-independent self-climbing system for forming the core. After weighing up a number of offers, the contractor decided in favour of the PERI ACS system, not least because of the high safety standard and proven technology.

Small core layouts mean only a minimum of space is available. Therefore, PERI used TRIO elements on ACS climbing units for the first time. With an overall thickness of only 12 cm, considerably more working area and clearance for striking on the internal and external platforms could be achieved compared to that provided by girder wall formwork. Furthermore, no basic assembly time for the formwork elements was required and the construction crew needed little time to get to grips with the handling through the simple use of the BFD alignment coupler in connecting the TRIO elements.

In spite of the large number of cast-in components which had to be taken into account for the subsequent steel structure, the 3.85 m high standard storeys could be completed in weekly cycles.

The totally enclosed construction provides optimum protection for site personnel. There are also no gaps or open edges during the climbing process as the units remain enclosed as they are lifted.





All formwork, working scaffold, storage areas and equipment for forming the internal and external walls are moved crane-independently in one single operation.

Contractor
Stumpf, Bruchsal
Field Service
PERI Weissenhorn

Hans Zimmermann
Site Manager

"The high degree of safety provided by this formwork solution impressed me right from the start, and was one of the main reasons for awarding the contract to PERI. The platforms on the outside completely enclose the core. Even during the climbing procedure, no gaps are formed which could present a risk of falling since all external platforms are lifted at the same time."


Stumpf
Stumpf
Stumpf

Florido Tower
Vienna, Austria

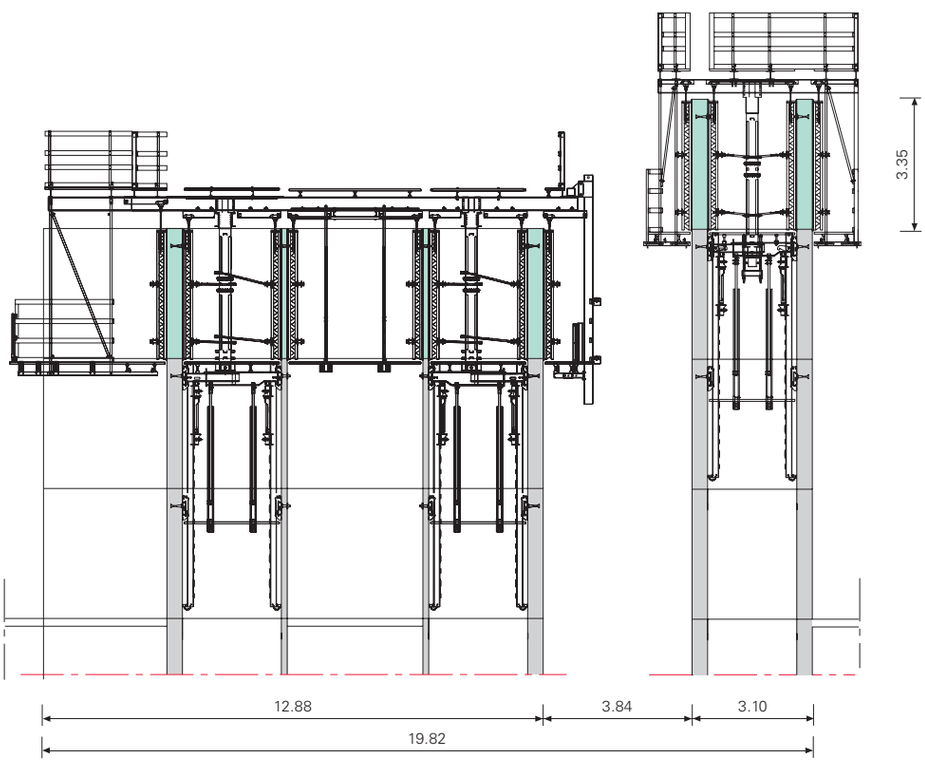
Centrepiece and eye-catching feature of the project: the 115 m high elliptical-shaped office block with 33 floors. The well-equipped working areas provide more than enough space for 1,600 employees.

Designed according to the latest technical standards, this modern highrise building project sets benchmarks in every aspect. The 115 m high tower - the dominant eye-catching feature of the project - soars above the Vienna Andromeda Tower (103.45 m) which was also constructed with the proven ACS self-climbing techniques in 1997/1998.

The construction sequence was marked by the standard approach: the stiffening cores of the building for the stairwells and elevator shafts climbed in advance of the following slabs. Climbing was carried out in two core groups without a crane, whereby one floor was constructed in weekly cycles using the ACS systems R, P and G together with VARIO girder formwork. The floor slabs followed at the same time with PERI slab table formwork.

The trapezoidal-shaped UNIPORTAL slab tables of up to 28.50 m², with double primary beams comprising strong GT 24 girders, allowed large prop spacings. Due to the rigid fixing of the MULTIPROP aluminium props in the UNIPORTAL heads, no diagonal bracing was necessary.

Both core groups climbed the floor slabs three and four storeys ahead in each case. All formwork units are movably suspended on a gallows frame.



Main Contractor
Porr Projekt und Hochbau AG, Vienna
Field Service
PERI Vienna and PERI Weissenhorn

500 m² of wall formwork and around 530 m² of platform area climb to the next concreting cycle. The platforms (loading capacity up to 3.0 kN/m²) serve as working areas and intermediate storage space for tools and materials.

With 100 kN lifting capacity, the ACS 100 climbing units guarantee safe operations.

Josef Lebinger
Site Supervisor

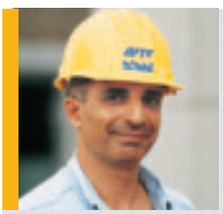
"I place great importance on safety and PERI systems certainly fulfil all safety standards. In PERI, we not only found the right formwork supplier, but also the most competent partner!"

Ocif-Aviv Tower City Gate
Ramat-Gan, Israel

This new development of a highrise office and business complex is situated directly in the Ramat Gan diamond district, one of the most modern areas in Israel. With 70 floors and a total height of over 252 m, the office tower is the tallest building in the Middle East.

The construction sequence and method was defined in advance by the project manager: the building´s core for elevator shafts and stairwells were to be concreted together with the external walls and floor slabs in one single working step.

PERI engineers decided to use the ACS R system for the facade on which the VARIO internal formwork is mounted - suspended on a gallows construction. Within the circular area, large formwork units (gallows construction) were moved using with a hydraulic carriage. With this cost-effective formworking method, the tight construction schedule could be maintained. Each month, five complete floors were finished, and this with only one shift of 40 workers.



Yair Tsabary
Project Manager

"With the ACS R system, we achive very fast construction progress. This can be attributed to the fact that we save on crane working time and manpower. The PERI solution is unbelievable! Without a doubt, it optimally meets the requirements of highrise projects and is safe, quick and cost-effective."

Contractor
Aviv & Co. Ltd, Ramat-Gan
Field Service
PERI Israel, Tel-Aviv; Barkai Ltd, Ramat-Gan and PERI Weissenhorn

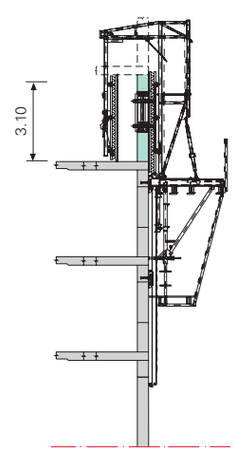
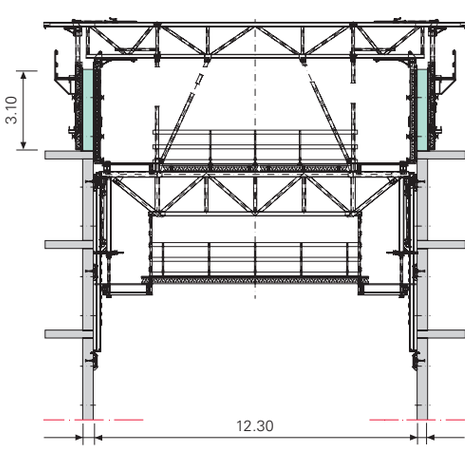


Photo (left): the slabs were formed with SKYDECK throughout. The aluminium components of this system are very light. The heaviest element weighs only 15 kg. This means that work can be carried out quickly over long periods of time as well as being almost effortless for site personnel. Without a crane, ten workers can form a slab area of 1,200 m² in only 12 hours.

The inside of the core is served by two platforms: platform A, with a size of 12.00 x 17.50 m, carries 450 m² of VARIO wall formwork and platform B, with 12.00 x 8.00 m², carries 200 m².



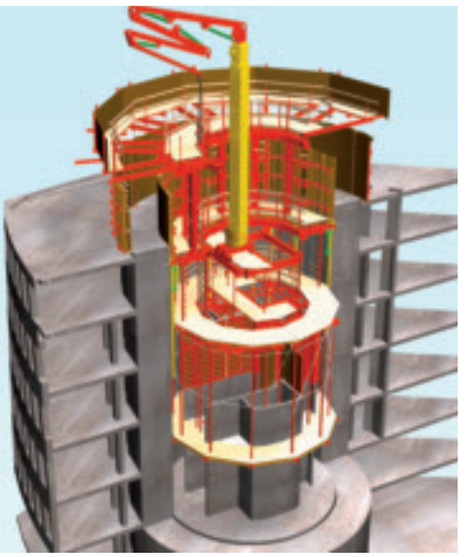
The facade consists of straight and curved wall sections which were formed together. 42 units of specially hinged box-outs fixed to the external formwork minimized the forming times required for the windows. 16 ACS R units on the outer side of the building carried 1,100 m² of VARIO formwork.

For the final storey section (Floor 61 - 70), the facade of the building changed considerably. Modifying the formwork and ACS R units was carried out mainly by the construction crews, with technical support being provided by PERI.

Turning Torso
Malmö, Sweden

Design sketch by architect Santiago Calatrava.
The residential tower is meant to be seen as a free-standing sculptural element inspired by the human body.

The core wall was formed with PERI GRV articulated walers and externally using PERI RUNDFLEX formwork. Adapting to the changing wall thicknesses was carried out with filler elements on the external formwork.



With help of the PERI ACS P self-climbing scaffold, the circular formwork for the core is moved hydraulically from floor to floor. The placing boom is positioned in the centre of the building. The self-climbing units for the formwork and concrete placing boom climb simultaneously.

The architect, Santiago Calatrava, designed this extraordinary residential highrise in the Western Harbour area of Malmö in Sweden. With a height of 190 m, The Turning Torso tower above all other buildings in the city. Each floor has an area of 400 m². The first two cubes contain offices with 15,000 m² available for 150 apartments from the third cube onwards.

PERI engineers designed the formwork to handle heights of 4.00 m which meant all floor heights - 3.18 m for standard areas up to a maximum of 3.89 m - were completed without the need of any height adjustment. The ACS P self-climbing concept allowed concreting of the ring wall on the main level and the re-tightening of the internal core walls one floor below. The ACS P was anchored on twelve fixing points.
The concrete placing boom was installed on its own climbing scaffold in the core.

Both self-climbing scaffolds are operated using the same control unit and all formwork elements are suspended on a distribution frame via a crane crab. Slabs and walls are cast in one pour. UNIPORTAL slab tables were used for two standard storeys and one intermediate arched floor which meant pre-determined concrete cycles could easily be maintained.

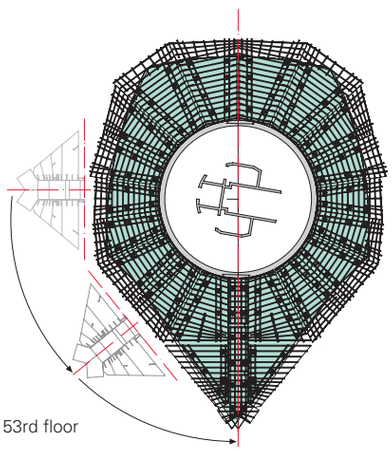
With construction crews needing nine days to complete a standard floor, construction work progressed exactly according to plan.

Jörgen Holm
Site Manager

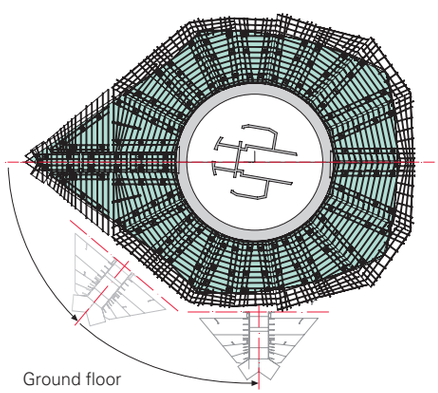
"PERI provided us with the best solution. All work could be carried out on safe and generously-sized levels. Shuttering and striking as well as climbing function extremely well."

Contractor
NCC Construction AB, Malmö
Field Service
PERI Weissenhorn and PERI Sweden, Malmö

The construction of the so-called Turning Torso has resulted in one of the most exciting buildings in Northern Europe. Designed by the Spanish architect, Santiago Calatrava, it is meant to be seen as a free-standing sculptural element inspired by the human body. The residential tower has 54 storeys and reaches a very impressive height of 190 metres.



53rd floor



Ground floor

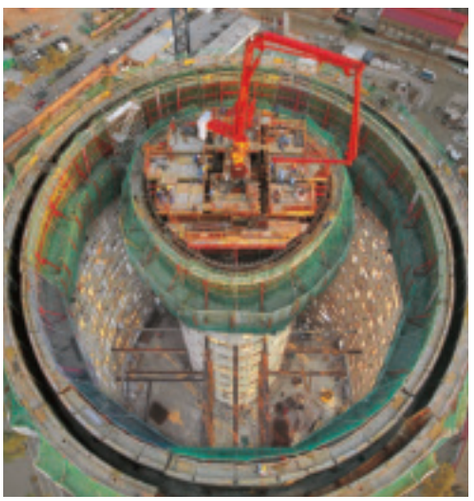
The whole building turns at an angle of 90° as it climbs upwards over nine cubes, with each cube consisting of five floors. The wall thickness of the core tapers upwards from floor to floor from a maximum 2 m to a minimum of 40 cm.

Torre Agbar
Barcelona, Spain

With 35 floors and 4 basements, this impressive office tower reaches a height of 142 metres. For the egg-shaped core and facade walls, up to four different curved radii had to be taken into consideration. In addition, the design included changing wall thicknesses and approximately 4,400 differently-dimensioned and irregularly positioned window openings.

Core
Corresponding to the construction progress and geometry of the structure, ACS R, ACS G and ACS P systems were used. The suspension of the ACS brackets was arranged radially. Through a frame construction on the ACS R working platforms, the formwork could be moved backwards and forwards on separate carriages, thereby allowing it to be easily stripped or shuttered.

Facade
The PERI VARIO girder wall formwork was adjusted to suit the different radii by means of spindles and to the changing wall thicknesses in 10 cm increments. For the facade, the ACS R self-climbing system was used to climb from the ground slab up to the 25th floor. From this level upwards, a steel and glass construction was used to complete the dome of the building. Here, the self-climbing system was adapted to the building's tapered contour by cutting the cantilever lengths.



The ACS P system carries the placing boom from floor to floor as well as the formwork, scaffolding and other equipment.

Luis Danoz
Site Manager

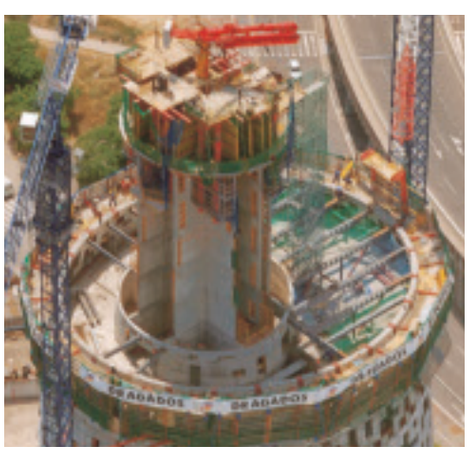
"I've been really impressed by the safety and the speed of the PERI system and, in spite of the complicated design of the building, we managed to complete each floor in a regular 5-day cycle. I don't believe there is another system around which provides the same high performance! "

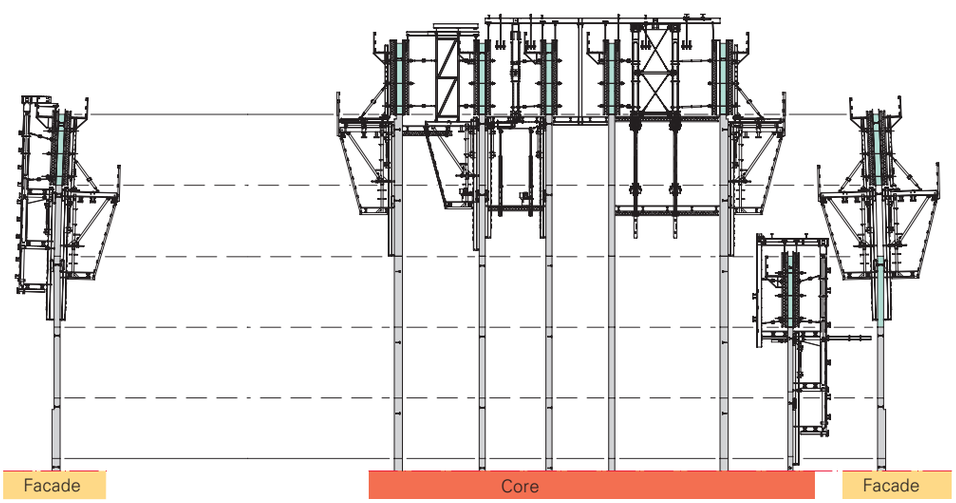
Contractor
Dragados
Field Service
PERI Weissenhorn PERI Spain and Madrid

The facade wall thicknesses tapered from 50 to 30 cm. The adjustment of the VARIO girder wall formwork was done in 10 cm increments.

The inner formwork of the core (suspended on a steel framework) is completely separated from the outer formwork as the working platforms in the domed area of the building cannot climb to the very top. These walls are concreted later with the slabs. The inner formwork, however, climbs together with the platforms right to the top.

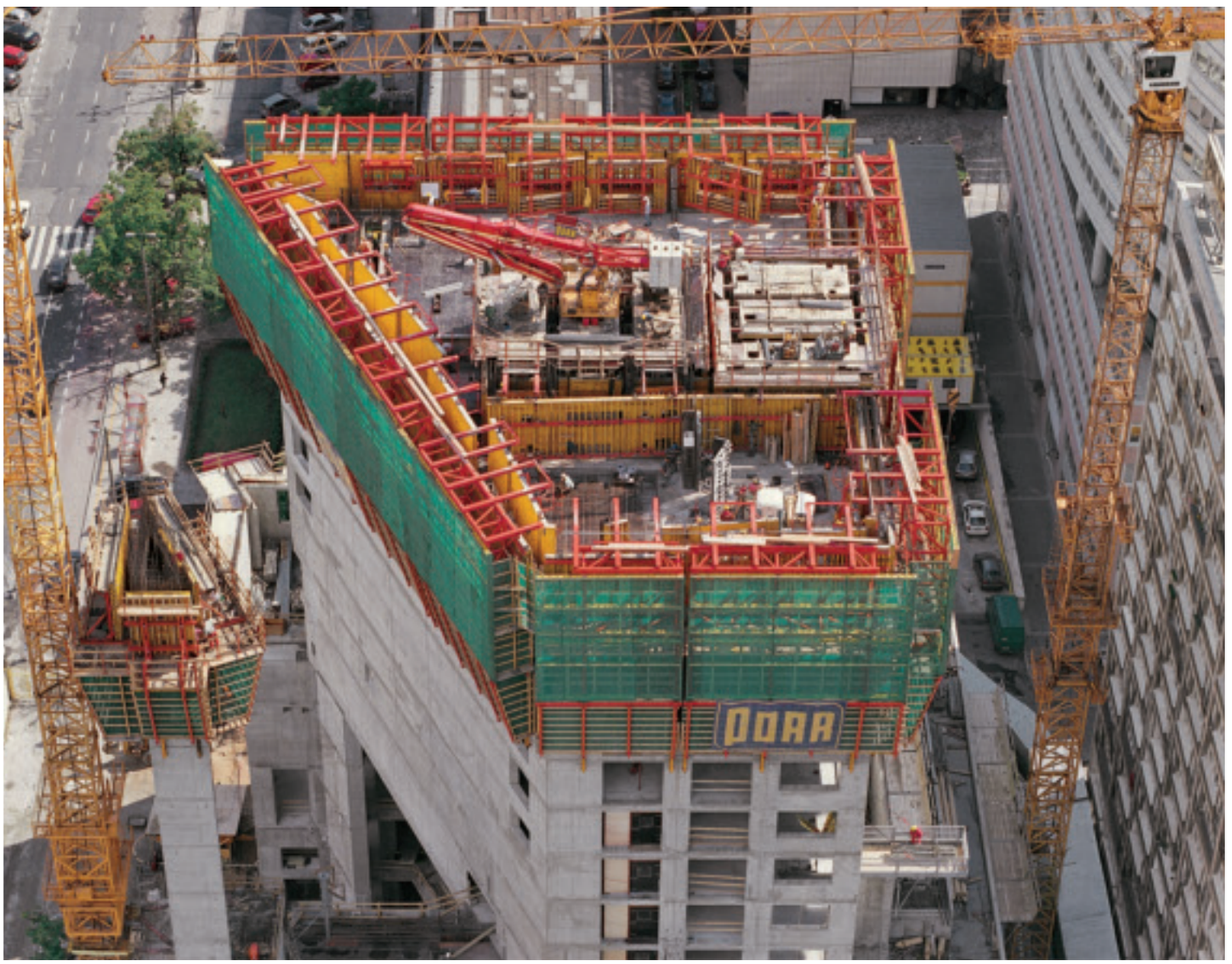
The outer wall of the core is completed with the elevator cores continuing above the 35th floor.






AXIMA
GALASA

Hotel Inter-Continental
Warsaw, Poland



The new Warsaw Inter-Continental Hotel has 50 floors with a total height of 163.60 m. The reinforced concrete shell of the building consists of a shear (core) wall and external walls together with columns and slabs. The contractors had to take into consideration the variable floor heights and wall thicknesses as well as the change from a trapezoidal to a rectangular-shaped layout on the 21st floor. Apart from the short construction time for the shell of only 21 months, things were made more difficult through the limited space on the site. Consequently, this required appropriate transportation measures for materials and equipment which was dependent on crane capacity and availability.

PERI used two versions of the ACS self-climbing technology. The ACS P for the building's core which consisted of two climbing platforms, P1 and P2. The ACS R for constructing the facade walls and triangular columns up to the 20th floor which was comprised of 15 climbing units assembled together.

The climbing platforms, working platforms and formwork consisted of approx. 50% PERI standard components which were rented by the customer for the actual construction period only. The PERI concept was successfully implemented on site by the contractors under the supervision of PERI specialists. As a result, a complete floor could be finished every four days.

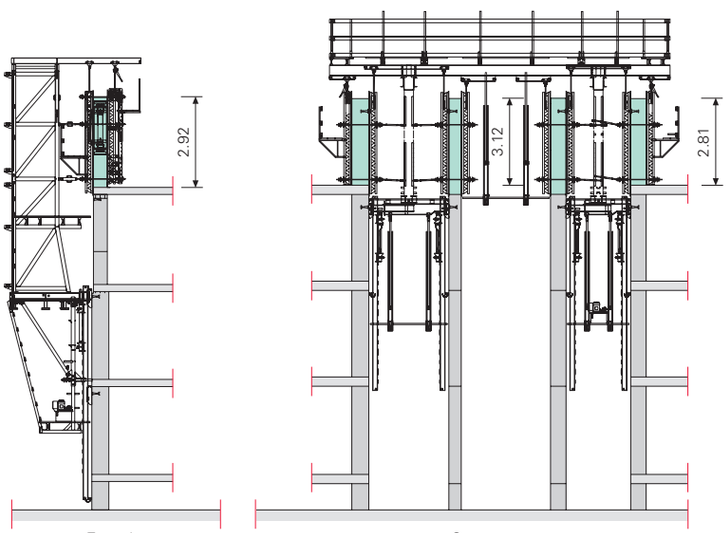
Main Contractor
Porr Projekt and Hochbau AG
Field Service
PERI Poland, Warsaw, and PERI Germany, Weissenhorn

Special PERI window boxouts were fixed to the VARIO external formwork. The construction saved time during shuttering and striking and allowed the formwork to be easily adapted to the changing wall thicknesses as well as the fast closing of the formwork.

Dipl.-Ing.
Roman Ehrentraut
Site Manager

"After extensive planning discussions with PERI, we decided to use the self-climbing PERI ACS P platforms for the core walls and the ACS R formwork for the facade. This allowed most of the wall formwork to be done without a crane which freed up urgently needed crane capacity for us. With the boxouts fixed to the external formwork which was specially developed by PERI for this project, we could guarantee that the position and size of all openings fitted perfectly."

Photo (right): 15 PERI ACS R climbing units on the facade (consisting of ACS main platform beams, trusses, distribution frame and 750 m² suspended VARIO wall formwork) were operated with 35 climbing devices and 5 hydraulic units.



Section of ACS R climbing unit with wall and window box-outs installed ready for concreting.

The platforms on the core are closed at the top with the distribution frame. Boarding serves as the concreting platform. The VARIO wall formwork is hung on the distribution frame using chain hoists. Carriages allow the formwork to be moved forwards and backwards.

The new Warsaw Inter-Continental Hotel is situated in the city centre close to the Kulturpalast. This was built in 1952/53 as a present from the former USSR.

Uptown Highrise and Campus Complex
Munich, Germany

The Munich Uptown construction project consists of a 146 m high multi-storey building, with three underground levels, ground floor and 37 upper floors, and four campus buildings, each with seven storeys and an underground garage with 790 parking spaces. Altogether, 84,000 m² of office space is available and the building itself is the highest office tower in the state of Bavaria.

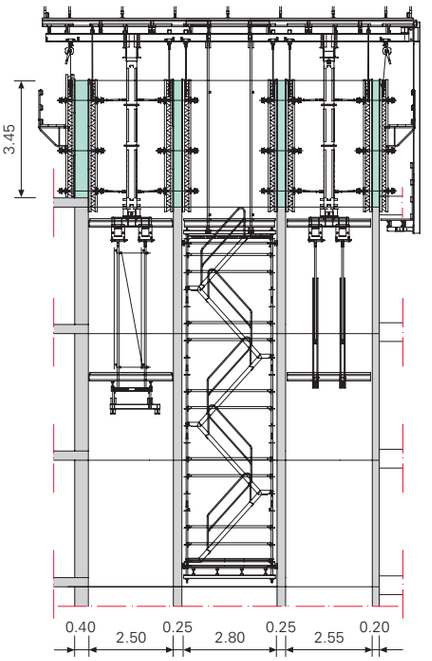
For construction of the highrise core, PERI ACS self-climbing technology was employed. Six ACS P units, each with eight ACS 100 climbing units, carried a total of 1,800 m² of VARIO girder wall formwork for the construction of the elaborate and gracile core. The slabs and rising walls were reinforced and concreted in one working cycle. Completely enclosed working platforms provided the highest possible degree of safety as there were no leading edges which could have been a fall hazard even during climbing operations.

At the request of the planners, 40 x 60 cm ventilation shafts also had to be formed at the same time. PERI engineers solved this problem with a special type of steel formwork which could be completely handled from the outside and was integrated in the self-climbing scaffold.

A specially-developed moving device, also integrated in the scaffold, allowed the moving of the slab tables from floor to floor without the use of a crane thus freeing up valuable crane time for other work on the site.

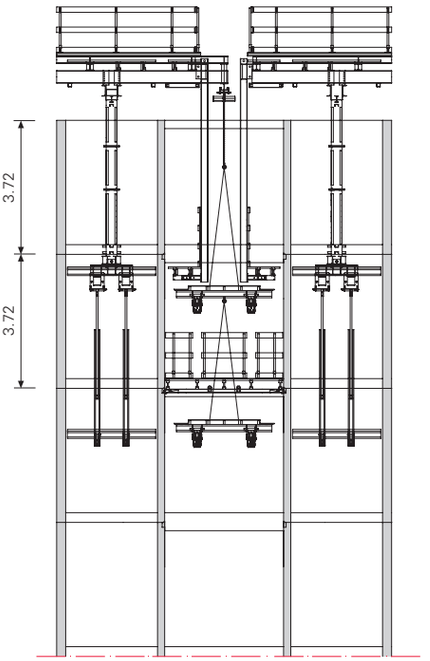
Excellent technical cooperation between PERI and the site team was a major factor in maintaining the very tight schedule and a complete storey could be finished on a weekly basis.

View of the core formwork and climbing protection panel which safely encloses the edges of the building and can be moved by crane.



The formwork elements could easily be moved for shuttering and striking along crane crabs on the ACS P girder grid. An integrated PERI UP scaffold stairway led directly to the working levels of the formwork.

The climbing protection wall provides a secure working environment even at a height of 140 metres.



Integrated in the self-climbing scaffold: a special moving device for re-positioning the slab tables from one storey to the next saved valuable crane time.

Carsten Harbusch
Deputy Project Leader

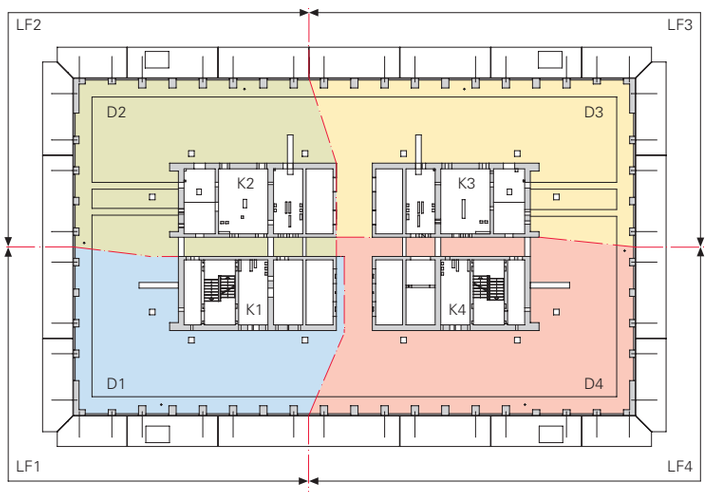
„The PERI formwork solution for this project can be recommended for use in all highrise construction work: the hydraulically-driven ACS climbing formwork with its integrated moving device for slab tables allows working without the need of a crane and the enclosure provides personnel and finishing crews reliable protection against the weather as well as safe working conditions!"

Contractors
Joint Venture Wayss & Freytag Ingenieurbau AG and Wayss & Freytag Schlüsselfertigbau AG
Field Service
PERI Weissenhorn and Munich

IBC Investment Banking Center

Frankfurt am Main, Germany

Three sides of the column formwork were mounted as foldable elements on the climbing formwork. The outside – like wall formwork elements – is firmly connected to the ACS 100 climbing scaffold.



The plan view was divided into four equal casting segments. This comprised of a core, around 40 linear metres of facade and a quarter of the slab area in each segment. Daily concreting cycles resulted in a complete storey being finished every four days.

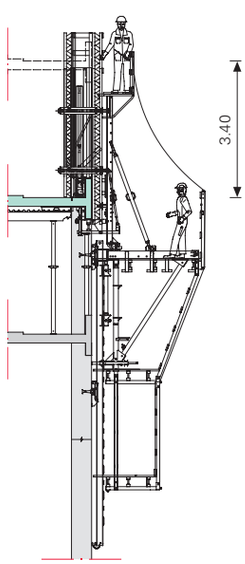
Casting sequence in a four-day cycle:

Day 1	LF1 + K1 + D3
Day 2	LF2 + K2 + D4
Day 3	LF3 + K3 + D1
Day 4	LF4 + K4 + D2

LF	Perforated facade
D	Slab
K	Core

Dipl.-Ing. (FH)
Horst Pullmann
Site Manager

"Based on the experience from previous projects, such as the BFG Highrise or Japan Centre, I know what I'm getting with PERI – there's absolutely no risk involved! Once again, the good cooperation and the proven PERI service paid off as we could make up a lot of time on the standard floors."



Section of the ACS R with integrated column formwork and foldable formwork for edge beams and parapets ready for pouring.

For the construction of the 112 m high Investment Banking Centre (IBC) office block, PERI engineers developed an efficient concept for the core, facade and slabs of the building. Dividing the layout into four clearly-defined sections meant that concreting could be done on a daily basis. As a result, a complete floor was finished every four days.

The formwork concept:

Core
The four cores were concreted in the same cycle as the corresponding facade section. The internal formwork for the core could be moved using special stripping aids placed on a shaft platform. PERI UP Rosett working platforms in the core chamber optimised the concreting and reinforcement work. The external formwork had integrated guardrails and was moved, together with the finishing and working platforms, by crane from cycle to cycle.

Slabs
The contractors decided in favour of SKYDECK aluminium panel slab formwork due to the easy handling and problem-free alignment. Through their high load capacity, MULTIPROP props provided the most cost-effective solution for the temporary support required for two storeys.

Facades
ACS R climbing units with VARIO girder wall formwork were used for the facades. The integrated foldable and spindled formwork, which was mounted to the climbing scaffold, proved to be especially time-saving when constructing the reinforced concrete columns of varying dimensions, corner walls and the 1.00 m high edge beam and parapet.

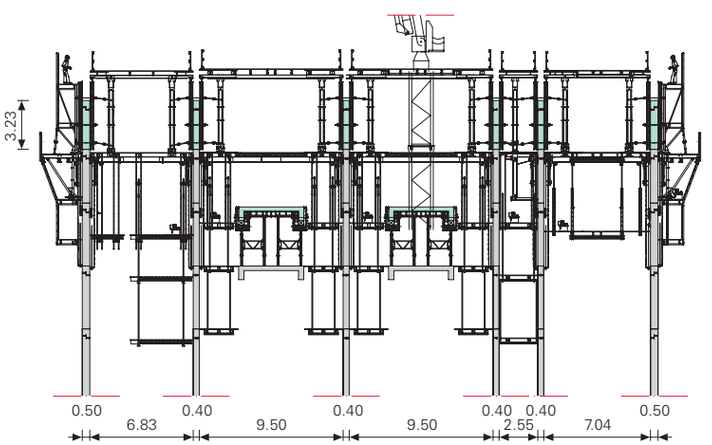
Contractor
IBC Consortium: HOCHTIEF AG NL Frankfurt, Phillip Holzmann AG, HN Frankfurt, STRABAG Hoch- und Ingenieurbau AG NL Rhein-Main-Neckar
Field Service
PERI Weissenhorn and PERI Frankfurt

HQ2 Building, Canary Wharf
London, United Kingdom

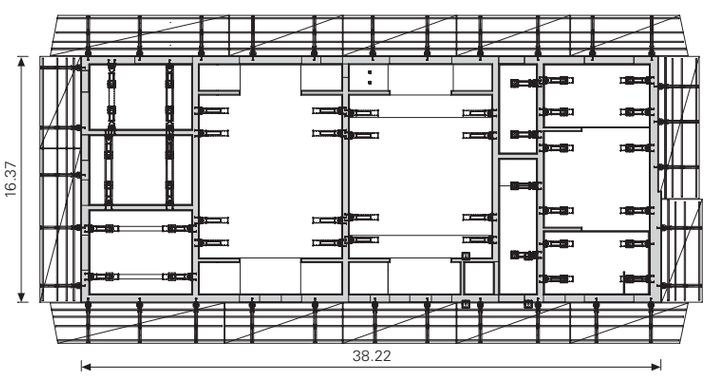
Specialist concrete frame sub-contractor Byrne Bros. (Formwork) Ltd, the first to use the PERI ACS system in the UK, were appointed by Canary Wharf Contractors Ltd to undertake the construction of the rectangular core for the 32 storey HQ2 office building block.

The robust design of the ACS self-climbing system and its adaptability to suit the project, together with their good experience with the system on previous projects, convinced Byrne Bros to use PERI formwork technology once again in preference to other available forming systems.

On the climbing formwork underneath the main working platforms, three suspended working levels were mounted. This allowed the boxed-out slab areas in front of the lifts to be concreted at the same time as the core walls two storeys in advance. With this method, the slab tables could be pushed on to the lower working platform in order to climb simultaneously with the core walls.



Section: a total of 1,850 m² of VARIO wall formwork was used for the core walls.



Plan view with overview of the platforms: the VARIO wall formwork was carried on 24 ACS platforms.

Bob Elliott
Project Manager

"Using the PERI ACS self-climbing formwork allowed us to pour 400 m³ of concrete in a 4-day cycle. This speed of operation was critical in maintaining our tight construction programme."

The Canary Wharf skyline in London is dominated by highrise buildings whose architecture represents modern British civil engineering.

ACS 100 climbing mechanism with platform cross-beams and suspension of the finishing platform.

Contractor
Byrne Bros. (Formwork) Ltd.
Field Service
PERI UK, Dartford, and PERI Weissenhorn

21st Century Tower
Dubai, United Arab Emirates

The 21st Century Tower with its 53 storeys, approx. 400 apartments and a total height of 269 m, is another constructional highlight along the Sheikh Zayed Road in Dubai.

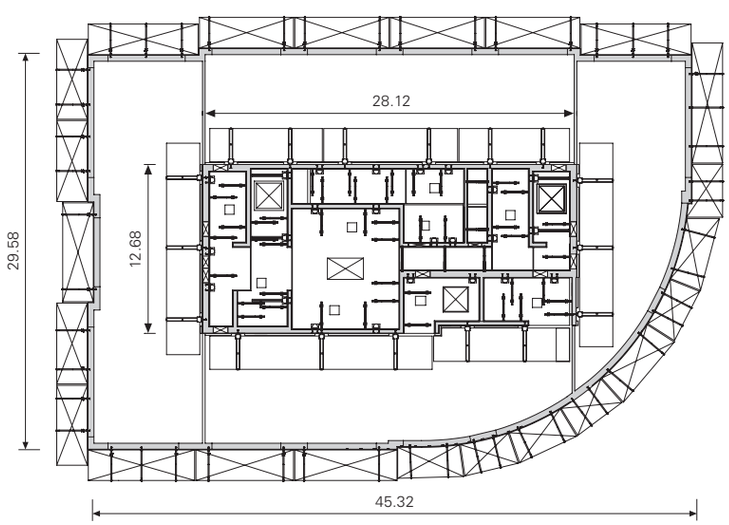
PERI Dubai was commissioned to provide a formwork solution which enabled the contractors to fulfill the high requirements as well as the tight construction schedule. Using experience from various successful projects in the past, such as the National Bank of Dubai headquarters and the Emirate Tower, PERI engineers also developed a clearly defined concept for this ambitious project:

Using ACS self-climbing technology, the VARIO girder wall formwork for the rectangular core climbed crane-independently from storey to storey. CB 240 climbing brackets and VARIO were used for the facades. The facade formwork could be retracted on the brackets for striking and then moved as a unit to the next storey by crane which saved a lot of time. MULTIFLEX slab formwork on PD 8 shoring towers for the slabs of the service and maintenance floor completed the PERI formwork programme used in this successful project.
Thus, the contractors could comfortably achieve the planned 3-day cycle for one complete 1,350 m² floor.

P. Schneider
Construction Manager and
G. C. Christofides
Project Manager

"PERI ACS is unbelievably fast and extremely safe. Due to the self-climbing technology, we could save on considerable amounts of crane capacity which is a big advantage on construction sites like this one."

Contractors
Joint Venture Arabtec Construction und Al Rostamani Pegel
Field Service
PERI UAE, Dubai



The core of the building is constructed in advance with ACS: the surrounding floor slabs and facade follow quickly using VARIO on CB climbing brackets.

Overview of platforms on core and facade.

I-Park Housing Project
Seoul, Korea

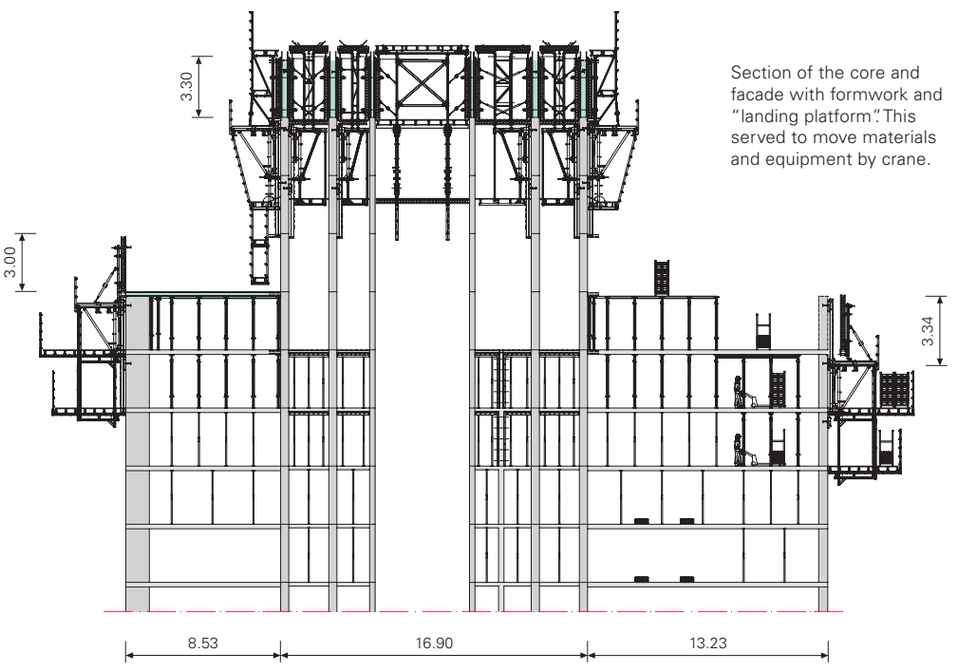
In the city quarter of Kangnam-Gu, the Hyundai Development Company constructed an impressive highrise housing complex of 450 luxury apartments in three 133 m, 156 m and 159 m high towers.
The extremely tight schedule placed high demands on the formwork suppliers – one complete floor would have to be finished in only four working days.

PERI engineers developed a comprehensive formwork concept that provided a cost-effective construction sequence for the contractor. VARIO GT 24 girder wall formwork together with ACS self-climbing technology was used on the cores and building facade and moved from floor to floor without the need of a crane. The so-called "landing platforms" or "superdecks", that extended over two floors, were also climbed automatically. In addition, as cantilevered material platforms, they served to bring materials and equipment from floor to floor by crane.

On the three towers, the VARIO GT 24 wall formwork on the core climbed in advance of that on the facades, followed by the floor slabs. These were formed using 750 m² of SKYDECK aluminium panel slab formwork per tower.
Site crews were able to achieve very smooth construction progress with the comprehensive PERI formwork solution.

Main Contractor
Hyundai Development Company
Contractor
Seryong, Duckil
Field Service
PERI Korea, Seoul

The construction site was located very close to the River han which flos through Seoul - a city with a population of more than 20 million.



Section of the core and facade with formwork and "landing platform". This served to move materials and equipment by crane.

Choi Young-Seok
Project Manager

"Through the use of the PERI systems, we could meet all requirements and at the same time reduce our labour costs. Without ACS and SKYDECK, we would certainly not have achieved the 4-day cycle for each floor and PERI´s ACS self-climbing technology also enabled us to save on hiring one tower crane."

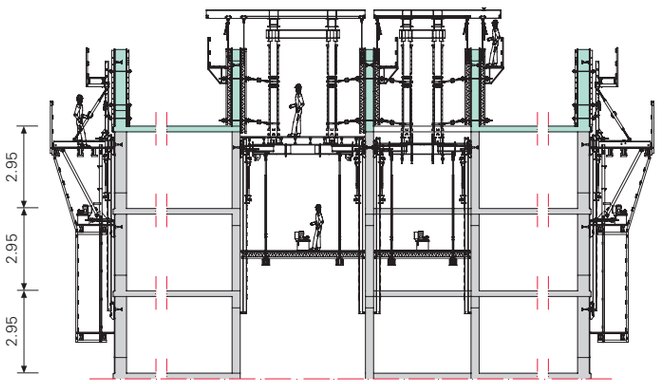
The VARIO formwork for the columns on the facades was foldable and integrated into the ACS units. Individual elements did not have to be dismantled for striking but could be climbed in units after opening without the use of a crane!

All working levels were fully enclosed to provide complete safety for site personnel.


PARK
한성젓갈
프로정신
효성

St. James Condominium Tower
Philadelphia, USA

Optimally coordinated working cycles ensured fast construction progress. The standard floors with core, slab and facade were completed in four-day cycles. The centrally-positioned placing boom was climbed with the ACS G units mounted on the core.



A section showing the ACS R self-climbing units on the facade as well as ACS P and ACS G on the core. The walls and SKYDECK-formed slabs were concreted in one pouring step.

With a total height of 156 m, the St. James complex is regarded as the first apartment highrise building in the city of Philadelphia. The 48-storey tower has over 300 apartments which can be purchased or rented.

The structure is comprised of a core for the stairwells and elevator shafts, floor slabs and a complicated facade - in-situ casting was used throughout the project. As had been the case many times previously, Carson Concrete decided in favour of PERI formwork technology. Using the ACS self-climbing system, VARIO GT 24 girder wall formwork, SKYDECK aluminium panel slab formwork and special steel formwork for the complex facade, PERI provided a cost-effective formwork concept. This enabled the experienced construction team to finish the project ahead of schedule as well as realising the demanding quality standards.

By using specially designed steel formwork elements, PERI was able to meet the high demands regarding cost-effective realization of the project along with ensuring a high quality facade surface finish. The foldable elements were mounted to the external ACS R climbing units and hydraulically climbed from floor to floor. This resulted in considerable time savings during shuttering and striking as well as providing urgently needed crane capacity.

Time-saving solution: foldable steel formwork elements fixed to ACS units which climb crane-independently.

High quality standards were achieved for the in-situ cast facade.

Contractor
Carson Concrete Corporation, Conshohocken, PA
Field Service
PERI USA, Baltimore

John Lewis
Site Manager

"The results we achieved using the steel formwork on the facade are unbelievable! Through the foldable elements attached to the climbing units, we could significantly reduce our labour costs. This was also a major factor in helping us maintain construction schedules."

Highrise Buildings

In the Spanish capital of Madrid, a superb multi-storey building complex dominates the skyline: the Cuatro Torres Business Area. Three of the four skyscrapers were constructed with the help of the ACS self-climbing technology: the Torre Repsol, Torre de Cristal and Torre Espacio (from left to the right in the photo).

Each of the impressive towers captivates the imagination through a distinctive style of architecture which in turn posed a demanding set of requirements on the ACS climbing system.

Cuatro Torres Highrise, Torre Repsol
Madrid, Spain

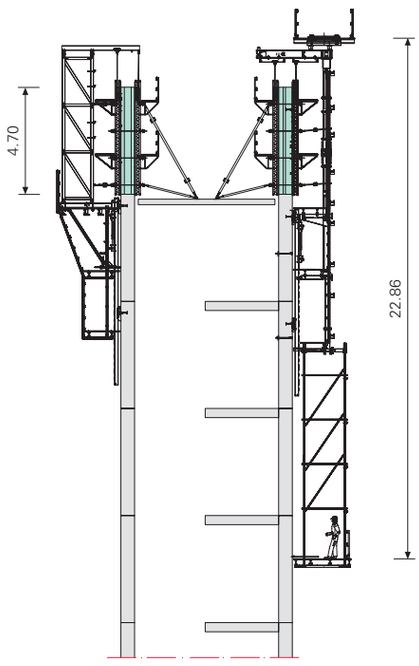
Rafael Ruiz
Site Manager
Torre Repsol, FCC

"The formwork solution developed by PERI and the ACS self-climbing system function extremely well. Once again, PERI has proved its strengths regarding quality and service."

Contractor
Torre 1 Consortium
FCC Construccion, Madrid
Dragados, Madrid
Field Service
PERI Madrid, Spain, and PERI Weissenhorn, Germany

With a height of exactly 250 metres, the Torre Repsol dominates the new multi-storey building complex and is the highest building in Spain. Sir Norman Foster, the renowned English architect and Pritzker Prize winner, designed this structure with two externally positioned reinforced concrete cores. Each core contains seven elevators, stairs and a service shaft. Between the two distinctive external columns, floor levels are arranged similar to that found in a shelving system. Three intermediate steel platforms carry eleven to twelve floors in each case.

The VARIO GT 24 girder wall formwork and ACS self-climbing formwork matched the complex ground plan with wall thicknesses between 30 cm and 2.00 m perfectly. During the operational planning, PERI engineers also had to take into consideration the site crane which was positioned in the core. From the supporting frame for the placing boom up to the lowest suspended finishing platform for the special steel fittings, the ACS unit had an overall height of 25 metres in the area of the elevator shafts. By using the PERI climbing solution, the contractors successfully maintained the planned 4.70 m floor height weekly cycle for both cores.



The 4.70 m high standard floors for the two cores of the Torre Repsol were completed in weekly cycles as planned. From the supporting frame for the placing boom up to the lowest suspended finishing platform for the special steel fittings, the ACS unit had an overall height of 25 metres in the area of the elevator shafts.

Torre de Cristal

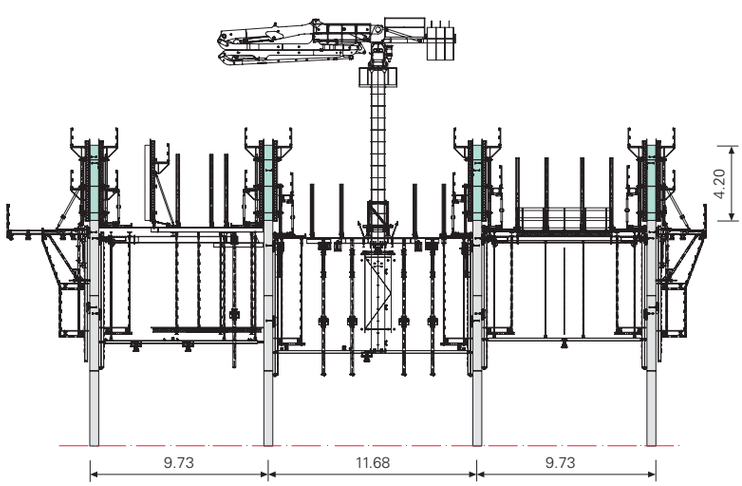
Luis Redondo
Site Manager
Torre de Cristal

"Through the use of the ACS and SKYDECK systems, our site is a prime example of efficiency and safety."

Contractor
Dragados, Madrid
Field Service
PERI Madrid, Spain, and PERI Weissenhorn, Germany

The 249 m high Torre de Cristal was the creation of the Argentine architect, César Antonio Pelli. For construction of the core, all three versions of the modular ACS system were used. The ACS R (R = Regular), ACS P (Platform) and ACS G (Gallows) can work in parallel ensuring optimal working procedures and, where required, can be efficiently and effectively combined. Altogether, 1,150 m² of VARIO wall formwork, including the placing boom, were distributed on ten individual climbing units.
As the building increases in height, the wall thicknesses taper from 1.20 m to 70 cm. Special adapters ensured that these offsets could be climbed over without any problems. After completion, the building was to have the appearance of a polished crystal and this effect was realized through the inclined edges on all four sides of the external facade. Through this, the core tapered over the course of several floors of the ground plan. Adjusting to the variable geometry with the resulting inclined walls took place with ACS and VARIO GT 24 within the system itself without the need to carry out time-consuming and expensive modification work.

Ten ACS climbing units carry over 1,000 m² VARIO as well as the placing boom. This meant that operational speeds could be continuously maintained independent of crane and weather which, in turn, enabled maximum productivity to be achieved.



Cuatro Torres Highrise, Torre Espacio
Madrid, Spain

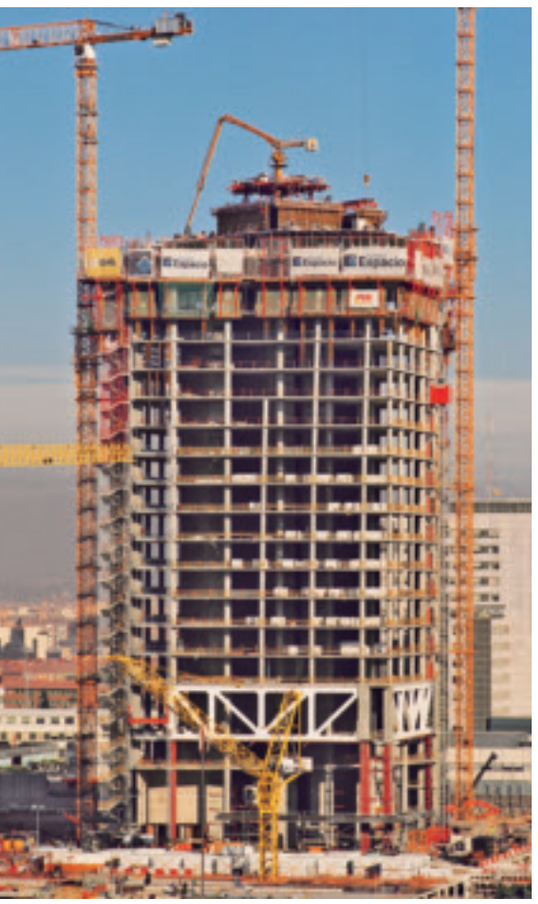
José Luis Martín
Site Manager
Torre Espacio

"Right from the beginning, the co-operation with PERI and the service they provided could not have been better. And with TRIO, PERI UP, SKYDECK and ACS, we had very efficient systems at our disposal. Once again, PERI proved why it is in top position."

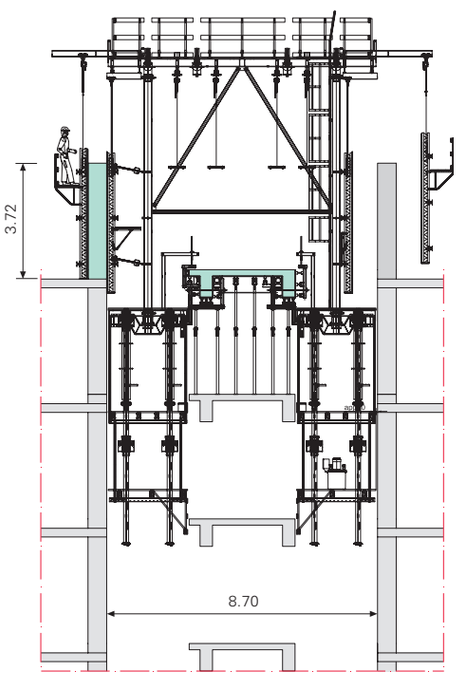
With its fifty-six floors, the Torre Espacio has an overall height of 223 metres. Around the three centrally-arranged cores, the initially square-shaped ground plan changes into an elliptical form. The 15 m x 10 m rectangular central core features varying wall thicknesses between 40 cm and 1.00 m. This is bordered by two U-shaped, 30 cm thick side cores.

Whilst the 120 m² VARIO wall formwork was mounted on only a single PERI ACS G self-climbing unit (G = Gallows) for the two lateral cores, additional requirements had to be fulfilled for operations in the central core. With the ACS P system (P = Platform), the contractors were able to simultaneously position 450 m² wall and slab formwork as well as the beam formwork in one climbing sequence. The central placing boom could also be climbed with the ACS P; a special steel construction ensured a safe transfer of loads via the ACS into the building itself.

In order to maintain the very tight construction schedule, other PERI formwork systems were also efficiently used. Lightweight aluminium SKYDECK slab formwork with integrated drophead, for example, allowed early striking to take place. The PERI UP Rosett modular scaffold system could also prove its versatility:
as type tested falsework for safe transfer of loads at large heights as well as for use as stair towers with alternating staircase units.



Contractor
OHL Group, Madrid
Field Service
PERI Madrid, Spain, and PERI Weissenhorn, Germany



In concreting cycle heights of 3.30 m to 4.40 m, and using only two ACS platforms, the wall, slab and beam formwork could be simultaneously climbed.


TECNICAS Y PROYECTOS DE BOMBEO

Oryukdo SK View Highrise Complex
Busan, Korea

With almost four million inhabitants, Busan is the second largest city in South Korea. The country´s most important port is situated about 400 km from Seoul at the south-east end of the Korean peninsula. Here, a new apartment complex was developed in a very favourable location directly on the coast. The buildings had different heights and, in part, very complicated layouts which required maximum levels of adaptability to ensure that the formwork system fitted the specific needs of the project.

A further requirement for the formwork solution demanded that the wall formwork and platform system be moved as a complete unit from floor to floor with a focus on time-savings and safety throughout, as well as being the most cost-effective construction method. All working processes – assembly, shuttering, concreting, striking and climbing – had to be safe and efficient along with problem-free implementation.

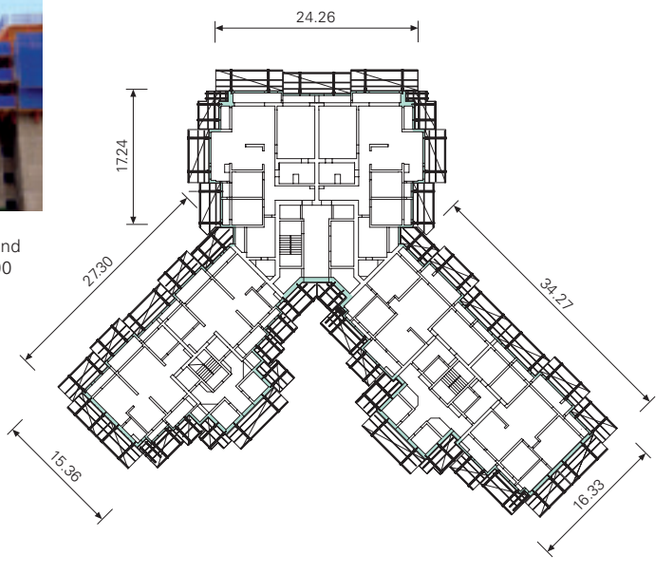
With the PERI concept for the formwork and enclosure using the RCS rail climbing system, the contractors could comfortably achieve the planned weekly cycles along with completing the concrete frame well on schedule.

With the PERI RCS (Rail Climbing System), the contractors were provided with a modular construction kit system which allowed different applications: as formwork scaffolding with carriage for forming the facade walls as well as a climbing protection panel for completely enclosing those upper floors still under construction.

In order to save crane time, the RCS was equipped or retro-fitted accordingly with mobile self-climbing devices. The use of mobile climbing hydraulics reduced the amount of materials required. This crane-independent climbing is therefore cost-effective for smaller building heights as well.

On the 50,000 m² area, a total of 15 multi-storeyed buildings, ranging from 70 to 150 metres high, have been constructed.

The individual highrise buildings have between 22 and 47 floors and provide enough space for around 3,000 high-quality apartments.

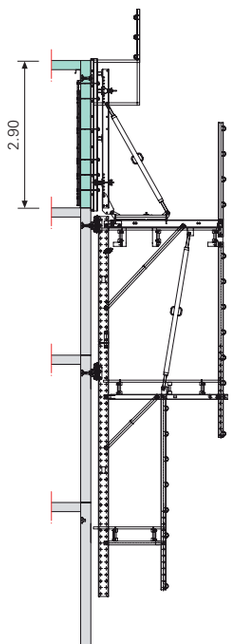


Ji-Young Park
Project Manager

"Formworking could be carried out quickly and efficiently with PERI ACS and, above all, without the use of a crane. The shell work could be completed after only twelve months."

Contractor
SK Engineering & Construction Co. Ltd.,
Seoul (General Contractor)
Jinsung dev. co.,
Busan Borim con. co., Seoul
Field Service
PERI Seoul, Korea

RCS as climbing formwork scaffold with concreting, working, hydraulic equipment and finishing platforms (illustration without climbing hydraulic). The complete unit is safely connected to the building during the whole climbing procedure.



In spite of its compact design, the hydraulic cylinder of the mobile climbing hydraulics has a 5 t lifting capacity.

Quick-release connectors save time when removing the climbing device on the climbing shoe. The hydraulic cylinders are simply moved to the next climbing unit.

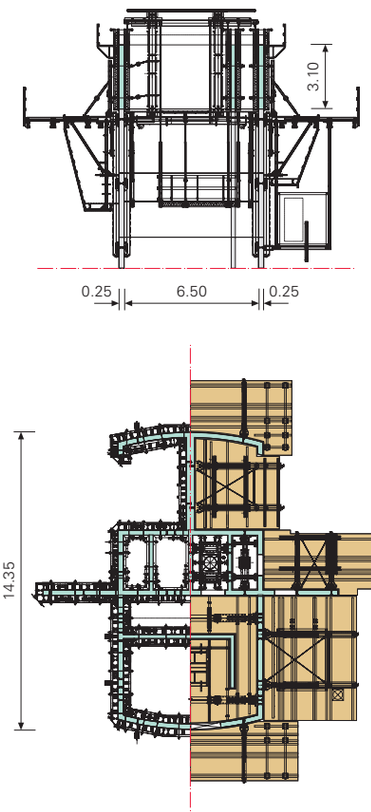
The hydraulic cylinder weighs only 25 kg which means it is easily moved by hand.

“Smalle Haven“ Highrise Complex
Eindhoven, Netherlands

Rising to a height of 96 m, the city of Eindhoven has a new landmark. The special form of the slender residential tower, together with the facade cladding comprising of glass and natural stone, lend a corresponding degree of elegance to the building.

28 storeys provide sufficient space for 44 apartments, and a total of 890 m² usable space is available for business premises. Two exclusive apartments, each with 130 m² living area, form separate floors at the top of the building.

For constructing the core, PERI ACS self-climbing formwork with nine ACS R platforms and three ACS P platforms were used. Two additional crane-assisted climbing units were utilised for the first five storeys.



The 3.10 m and 3.50 m high casting segments were constructed with PERI ACS self-climbing formwork in 5-day cycles. Site personnel were able to climb safely and without the use of a crane in all weathers. Load-bearing ST 100 stacking towers were used to support the cantilevered slab areas.

Rini Martens
Site Manager

“Already in the preparation phase, PERI provided us with the best formwork concept. Their vast experience with climbing formwork, the proven systems and solid support were the decisive factors when awarding the contract. During the construction phase, we were given great support by PERI Netherlands.
We climbed the core in weekly cycles. Using SKYDECK and UNIPORTAL tables for constructing the slabs worked extremely well.”

Early striking with the SKYDECK drop head system. The large prop spacing facilitates horizontal transportation of formwork and building materials.

For forming the walls, 490 m² VARIO GT 24 girder wall formwork and 130 m² TRIO panel formwork were combined. Access to the shafts was made possible through specially designed (door) openings in the formwork. A separate climbing unit allowed incorporation of the placing boom.

Contractor
Van Straten Bouw en Vastgoed, Eindhoven
Field Service
PERI Schijndel, Netherlands, and PERI Weissenhorn, Germany

The European Court of Justice
Luxembourg

The European Court of Justice is the judicial branch of the European Union and is based in Luxembourg. Since 1973, a number of extension measures have had to be carried out. In the fourth and most extensive development section - which became necessary due to the admission of new EU member states from Eastern Europe - another 50,000 m² of office space had to be created. In each case, 27 floors are accommodated in the 106 m high twin towers.

Altogether, 1,760 m² of VARIO wall formwork for the four reinforced concrete cores was climbed with the help of the ACS self-climbing system in accordance with the planned weekly cycle. The combination of three versions of the modular ACS system provided an optimal operating sequence. Even the formwork for the intermediate walls and the placing boom could be comfortably integrated into the climbing units. The patented ACS 100 climbing mechanism, the core element of the modular ACS system, brought the platforms together with the formwork smoothly up to the next section without the need of a crane. The crane was only used for the reinforcement work and forming the in-situ concrete slabs.

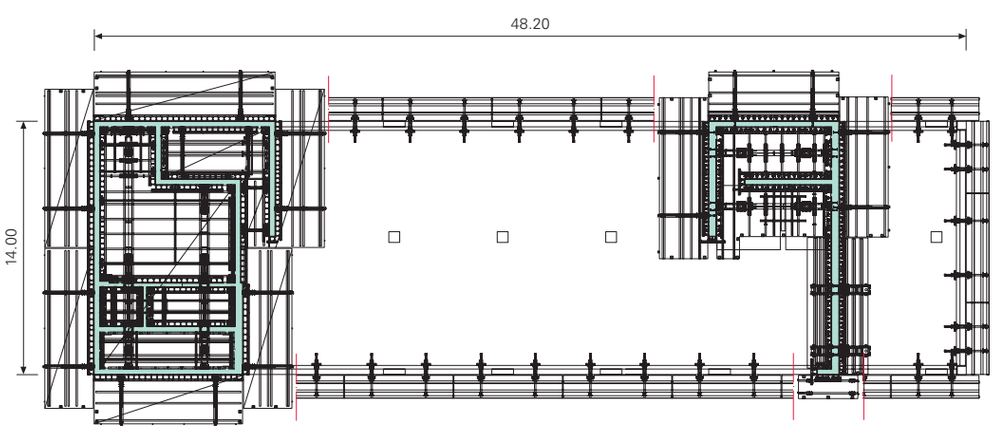
Subsequent work on the office floors could be carried out in absolute safety, and therefore more efficiently, due to the protection provided by the RCS climbing protection panel. This meant shuttering and striking with the SKYDECK slab formwork could be carried out regardless of wind and weather on several storeys at the same time. In addition, due to the use of the SKYDECK drophead system, panels and main beams are free to be used for the next floor area after only two days.

Patrick Federmeyer
Project Superintendent
Claude Johann
Technical Director
Florian Krämer
Project Manager

"We decided in favour of PERI due to the high safety levels provided by the ACS self-climbing formwork and RCS climbing protection panel. The professional PERI formwork planning and support was also a decisive factor."

For the structured ground plan, all three ACS versions worked alongside of each other:
ACS R (Regular) for the large-area wall formwork;
ACS P (Platform) for the internal core;
ACS G (Gallows) for the intermediate walls.

Contractor
KURT Constructions S.A.,
Bridel, Luxembourg
Field Service
PERI Londerzeel, Belgium
and PERI Weissenhorn, Germany



The ground plan drawing shows one of the twin towers with integrated stair and elevator cores. The combination of ACS self-climbing formwork and RCS climbing protection panel provided site personnel with the highest levels of safety. Even during high wind speeds, floors could be constructed with concreting cycle heights of 3.80 m in regular week cycles.


PERI

Naberezhnaya Tower
Moscow, Russia

Mustafa Zirtiloglu
Site Manager

"After a jointly-prepared concept, PERI developed a VARIO and ACS formwork solution with which all technical requirements were cost-effectively fulfilled. The technical support was also outstanding during the construction phase."

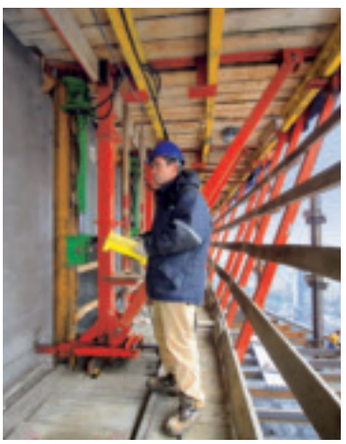
The skyscraper-dominated Moscow City development is currently the largest building project in Europe, and should satisfy the large demand for centrally-located offices with good transport connections in the Russian capital. Construction of all multi-storey buildings will be completed by 2012.

Number 10 Complex, the Naberezhnaya Tower, offers altogether 150,000 m² of modern and high-quality office facilities. This building ensemble comprises of three individual towers with 17, 27 and 59 storeys respectively. Construction of the 285 m high C-Towers began in 2005 - after completion of the other two buildings.

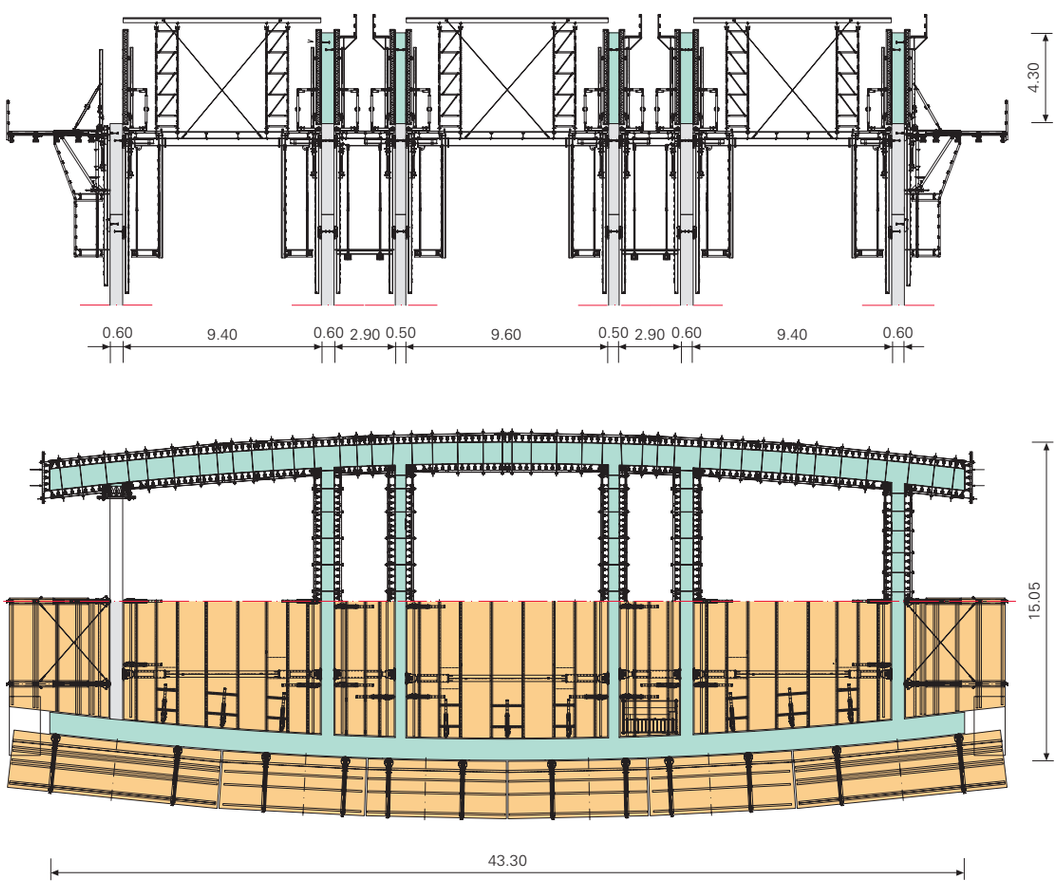
With VARIO girder wall formwork and the ACS self-climbing system, the up to 1 m thick curved external walls of the building core could be formed together with the inner walls without the need of a crane. In so doing, the externally-mounted ACS R units were climbed in advance and thus provided effective protection against the wind. The internal formwork was moved with ACS P platforms without a crane and positioned by means of a carriage.

The VARIO external formwork climbed on ACS R platforms in advance and thus provided effective wind protection for the reinforcement work.

The building core with convex external walls was cost-effectively constructed in 4.30 m high concreting cycles without requiring a crane and in all weathers.

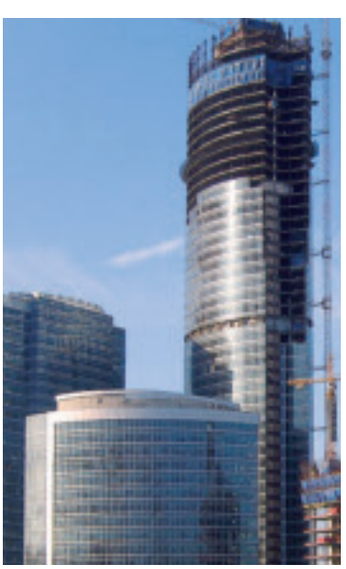


Using a remote control, three ACS platforms could be easily and safely moved at the same time.

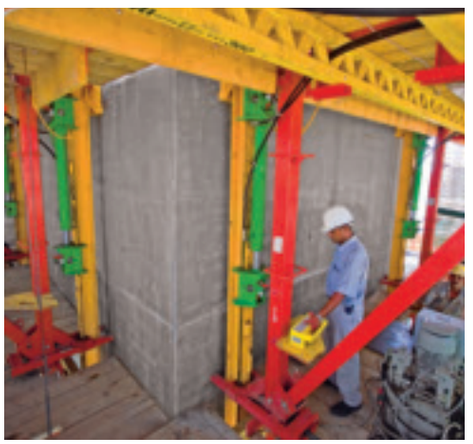


Contractor
Enka Insaat ve Sanayi A.S., Moscow
Field Service
PERI Moscow, Russia and PERI Weissenhorn, Germany

The reinforced concrete core of the 285 m high C-Tower tapers incrementally at the 28th and 46th floors from an initial 43.30 m to 23.40 m.

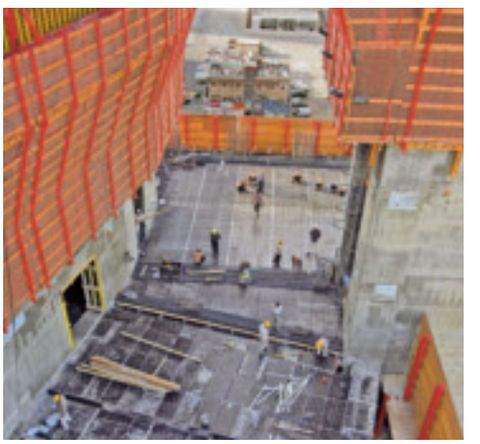


Arraya Office Tower
Sharq, Kuwait

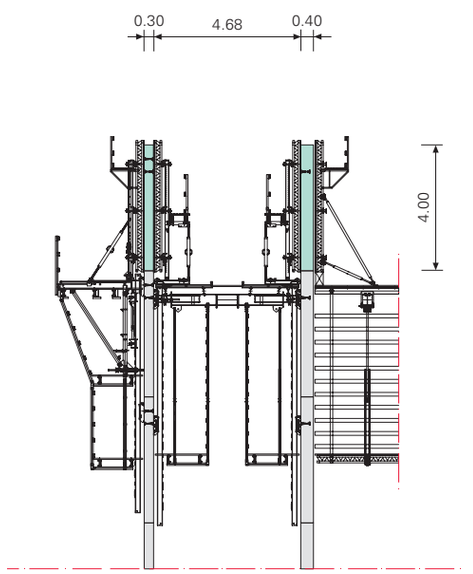


Construction of the two separate reinforced concrete cores took place in advance with ACS self-climbing technology and VARIO GT 24 girder wall formwork in regular weekly cycles. This meant shuttering, striking and climbing could be carried out without the use of a crane and in all weathers. For optimal working procedures, two versions of the modular ACS system operated next to each other. The placing boom was also lifted with the ACS from section to section.

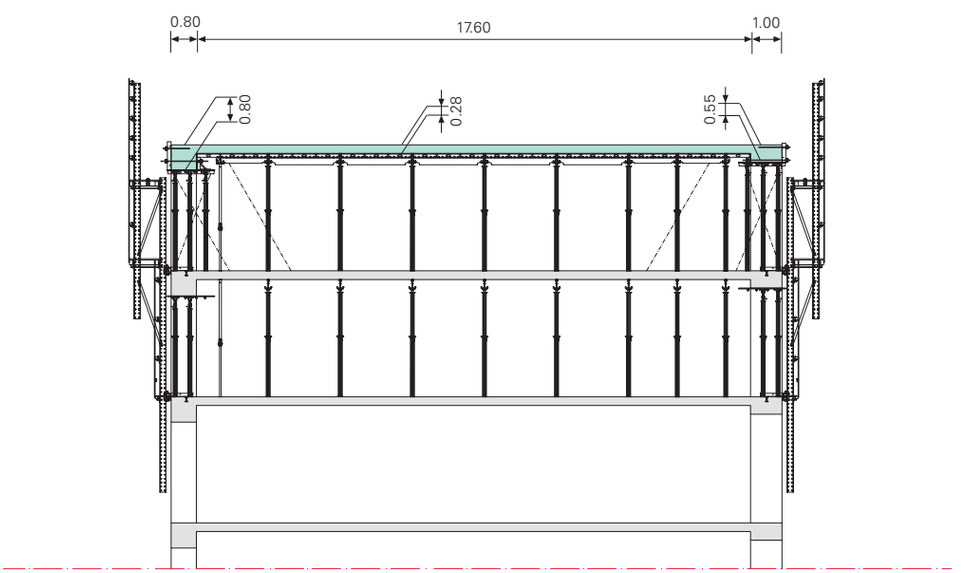
The RCS climbing protection panel completely enclosed the slab edges of the trailing floors. Protected against strong winds, construction site personnel could work safely and productively in the top three storeys each time even at great heights. Mobile self-climbing devices from the RCS modular system ensured crane-independent climbing with reduced and therefore cost-effective on-site material requirements.



In order to be able to maintain the planned weekly cycle, also when constructing the slab floors, the 850 m² area on each storey was formed using the SKYDECK system. The lightweight aluminium elements allowed simple, non-tiring and fast assembly throughout. Because of the drophead, early striking could take place. This meant that the main beams and panels were freed up to be used for the next cycle.



With the ACS self-climbing system, the 4.00 m high casting segments of the reinforced concrete core could be safely constructed without the use of a crane, and regardless of the weather.



In the secure conditions provided by the RCS climbing protection panel, work could be efficiently carried out even with high wind speeds.

Through the SKYDECK drophead system, the main beams and panels required for constructing the next floor could be struck earlier than usual.

Attia Yousef
Project Manager

"The PERI systems we used contributed significantly to the fact that concreting steps could not only be carried out quickly at great heights but also extremely safely."

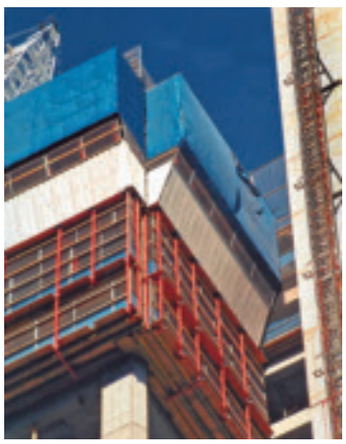
The Arraya Complex in Kuwait City is dominated by the new 240 m high Arraya II multi-storey building. The office and administration structure, with altogether 58 floors, is almost twice the height of the adjacent hotel building which was finished in 2003. In order to be able to complete the planned construction as efficiently and safely as possible, the contractors decided in favour of a rational combined use of ACS self-climbing formwork, RCS climbing protection panels as well as the SKYDECK panel slab formwork. The 4 m standard floor heights featured slab thicknesses between 17 cm and 28 cm.

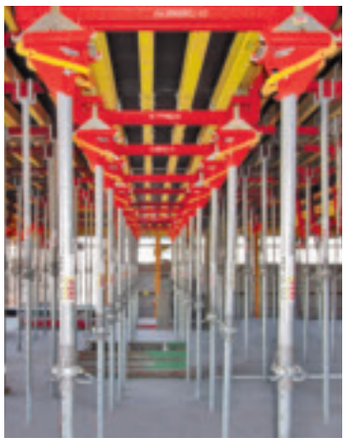
Contractor
Ahmadiah Contracting & Trading Co., Kuwait
Field Service
PERI Kuwait and PERI Weissenhorn, Germany

126 Phillip Street
Sydney, Australia

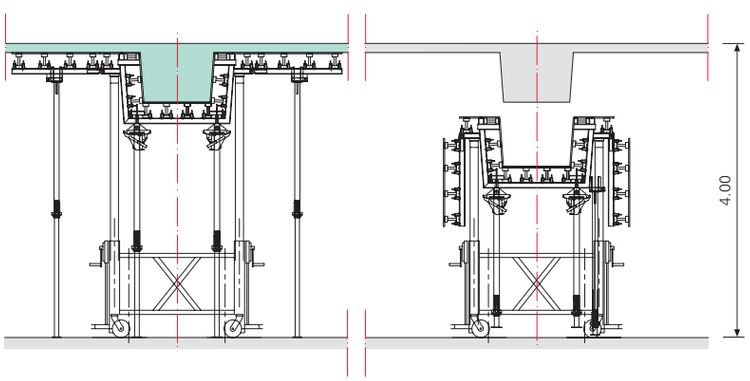
Contractor
WIDEFORM Constructions Pty Ltd, Wollongong
Construction Management
Bovis Lend Lease, Sydney
Field Service
PERI Glendenning, Australia

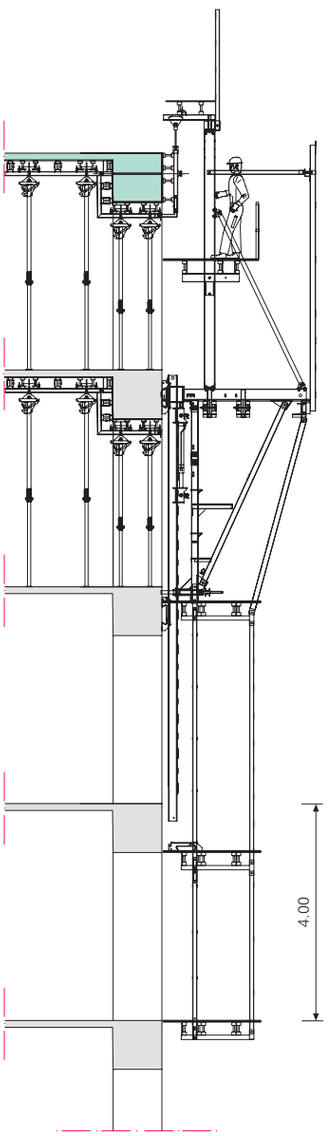
The comprehensive planning and provision of the formwork solution, and the climbing protection panel, simplified site operations and provided positive synergy effects.





For construction of the slabs and beams, special slab tables guaranteed fast moving times. After the side sections had been folded up, the table was then easily transported with the trolley.





The main building in the east and the development through the west facade are connected by means of so-called connection plates which pass through the highest atrium in Australia.

Rodney O'Neill
Construction Manager,
Bovis Lend Lease

"I was already able to use the PERI systems very successfully for my previous highrise projects. In connection with the first-class engineering, our high requirements regarding health and safety protection could be therefore be fulfilled."

The Sydney skyline is known throughout the world. Since 2005, however, the city´s appearance has been re-shaped by the new multi-storey building located at 126 Phillip Street. The 240 m high building complex was designed by the renowned British architect Sir Norman Foster and is the new home of Deutsche Bank Australia.

The 38-storey main building with a ground plan area of 65 m x 22 m has standard floor heights of 4 m. With the help of the ACS climbing formwork solution, VARIO system components for the beams and reinforced concrete columns as well as PERI slab tables, a comprehensive PERI formwork solution was designed with which the reinforced concrete slabs along with the edge and intermediate beams could be constructed in only one concreting step together with the columns. This meant that a complete floor could be climbed in only four days.

Altogether, 16 ACS self-climbing units were used to form the edge beams as well as the reinforced concrete columns which were positioned on the outside. At the same time, the five upper floors could be effectively protected against the wind and inclement weather along with preventing site personnel from falling. As the building edges were completely enclosed, extremely safe conditions were provided for all subsequent work requirements. Crane-independent climbing procedures took place with the ACS, and in all weathers.

After concreting, the VARIO column formwork could be retracted by means of a formwork carriage and then climbed with the ACS to the next section. Within each floor itself, the slab tables were moved using the PERI transportation trolley which saved both time and money.

RONDO 1 Building Complex
Warsaw, Poland

ACS, VARIO, SKYDECK on MULTIPROP towers, SRS, TRIO and the climbing protection panel cost-effectively combined.

The PERI climbing protection panel provides personnel with extremely effective protection against falling and weather conditions. This naturally increases productivity levels.

With SKYDECK, panels and main beams can be struck within a very short time so that they can be immediately re-used in the next casting segment.

The 40-storey RONDO 1 highrise project provides the Warsaw financial centre with a new and exciting image. Architectural highlights of the 194 m high office block are three external, transparent elevator cores which contain a total of 18 lifts as well as the so-called sky bridges which serve as access points to the various levels.

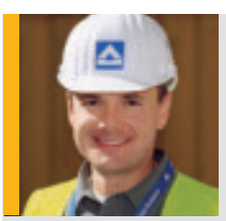
In the area of the core walls, the ACS P (platform) self-climbing version provided generous working areas. For the retaining wall sections, the ACS R (regular) system was used which served as self-climbing brackets for the VARIO girder wall formwork.

Both versions were moved crane-independently with the help of the ACS 100 hydraulic climbing mechanism to the next casting segment without jerking, almost noiselessly and without the need of intermediate anchors.

Simultaneous climbing of up to four platforms took place automatically and force-actuated with only one unit. A completely level surface with no height differences resulted which greatly minimized any risk of falling.

PERI fulfilled the requirements regarding the enclosure of the upper floors undergoing construction using a very manageable solution whilst simultaneously providing extremely safe working conditions: the PERI climbing protection panel completely enclosed the edges and was also safely connected during climbing operations to the building by means of climbing rails and shoes. Hinged covers prevent any tools or other objects from falling off. This meant that facade work for the floors directly below could be safely carried out.

The SKYDECK system, with its lightweight individual components, ensured quick and almost effortless shuttering and striking operations for the flor slabs. For the formwork crews, the assembly grid itself - props, main beams and panels - was quickly mastered and was an important factor in accelerating shuttering times. 1,800 m² of SKYDECK materials were supplied for constructing the slabs in the 40 storeys. Due to the drophead system, early striking of the main beams and panels could take place with the props remaining in position as tempoary support. Altogether, a gross flor area of around 100,000 m² was built.



Engineer
Dariusz Kolasa
Site Manager

"I´ve been involved in the reinforced concrete construction business for over ten years and we´ve built many structures with a wide range of requirements during this time. PERI formwork systems have always proved to be very efficient and universal in their use. The PERI self-climbing technology used in this project has also convinced me because the system works reliably, crane-independently and is very safe. In connection with the extremely professional technical service and the reliable logistical operations, PERI has provided optimal support for the realization of the Rondo project."

Contractor
HOCHTIEF Polska Sp. Z.o.o., Warsaw
Field Service
PERI Warsaw, Poland and PERI Weissenhorn, Germany


RONDO 1
RONDO 1

Paragon Development, Block G,
Brentford, London, UK

The RCS modular system for rail-guided climbing can be used as a climbing protection panel as well as formwork scaffold with carriage. In order to save crane time, the RCS could be partially equipped or retrofitted with mobile self-climbing devices. This resulted in on-site material requirements being reduced and economical crane-independent climbing for even smaller building heights.

With the Paragon building complex, the Thames Valley University has an additional 12,000 m² teaching facility. In addition, 221 key worker apartments and 839 student study bedrooms were created. The largest of the buildings is 'Block G' with 12 storeys.

For developer and main contractor, Berkeley First, the building project was a technical and logistical challenge as the structure is situated in very close proximity to the elevated section of the M4 motorway. This imposed an unusually demanding series of health and safety requirements. Even during the tendering phase, plans for the concrete frame construction had to be approved by the Highways Agency as well as the local council.

Close cooperation with PERI engineers provided a detailed risk assessment at an early stage outlining the systems to be used. The main focus here was guaranteeing a safe working environment at heights of 50 m in order to achieve safe and cost-effective construction. PERI provided not only the supply of the formwork and scaffolding systems but also was on hand to give support during planning and assembly.

With the RCS climbing protection panel, the edges on three storeys could be completely closed which meant site personnel were protected against falling at all times. This accelerated the moving of the slab formwork and thus increased the productivity. As the RCS remained connected to the building by means of climbing shoes during rail-guided climbing, workers were also completely safe during the climbing process.

The SKYDECK panel slab formwork, with the cantilevered SLT 375 main beam for the slab edges, also made a significant contribution in increasing working safety levels as it was assembled from below. In addition, the lightweight system components and a pre-determined assembly sequence speeded up the construction progress. Thus a 10 working day cycle could be achieved per floor.

With PERI SKYDECK, the 25 cm to 33 cm thick reinforced concrete slabs could be safely and cost-effectively formed. Adjusting to ground plan requirements was carried out with SDR triangular frames.

The RCS climbing protection panel encloses the edges of the building even during the climbing process. In addition, hinged covers prevent any tools or other objects from falling off.

Shahin Khazali
Project Manager

"The RCS climbing protection panel ensured a safe working environment at great heights affording protection from high winds and inclement weather. The system is also very fast and easy to assemble. Ultimately, we had no problems in maintaining our schedule."

Contractor
A. J. Morrisroe & Sons Ltd, Borehamwood
Field Service
PERI Rugby, UK

Site personnel are protected against falling at all times. Work can be carried out more safely and quicker without being subjected to the negative effects of wind and weather.


GRAND PLAZA
APARTMENTS
312-64-GRAND
Bovis
Bovis

Highrise Buildings

The 415 m high Trump International Hotel and Tower, situated directly at the Chicago River, is an impressive skyscraper which dominates the skyline of Chicago.

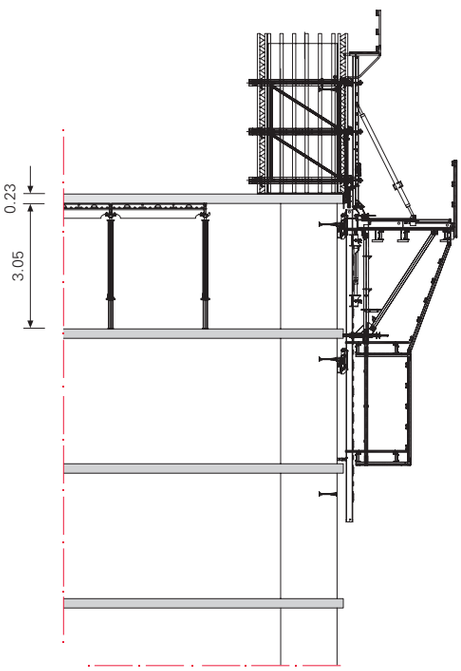
The top floor is located on the 92nd storey at a height of 345 m. The remaining 70 m is taken up by a slender spire. The building has both residential condominiums with 472 luxury apartments as well as a hotel with 286 five-star rooms. In addition, numerous restaurants and shops are integrated in the lower levels.

Trump International Hotel & Tower
Chicago, USA

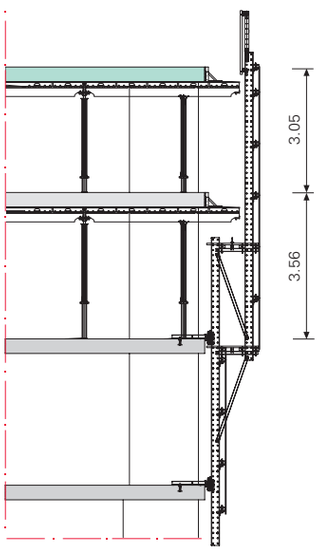
Contractor
James McHugh Construction Co., Chicago
Field Service
PERI Chicago, USA
and PERI Weissenhorn, Germany

The floorplan for this impressive building complex tapers gradually in four steps as it rises majestically in the air: at heights of 65 m, 121 m, 201 m and 338 m. With the PERI formwork and scaffolding solution, these ground plan changes could be accomplished without any time-consuming and costly modifications.
The biggest challenge consisted of continuously finishing a complete storey on a weekly basis. This ambitious plan could only be realised with fast and safe systems combined with high levels of material usage. Therefore, over 16,900 MULTIPROP aluminium post shores and 2,600 PEP steel props were needed at the same time for the shoring alone on the lower levels. Using SKYDECK with the drophead system meant that the slabs could be struck after only two days.

The massive reinforced concrete columns on the north and south sides were constructed with the ACS climbing system and the VARIO girder wall formwork which freed up valuable crane time. At the same time, the ACS platforms also functioned as protection on the slab edges against falling. PERI engineers developed customized climbing units for the column and climbing rail spacings of 9.10 m.



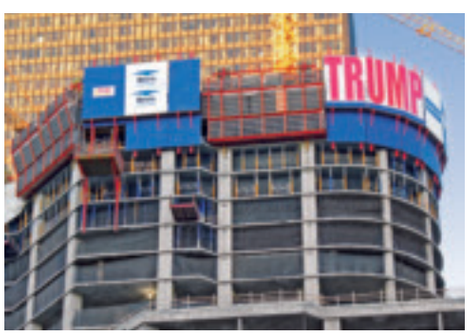
With the ACS, climbing could take place in all weathers without crane support - the planned operational speeds could therefore be maintained without any problems.



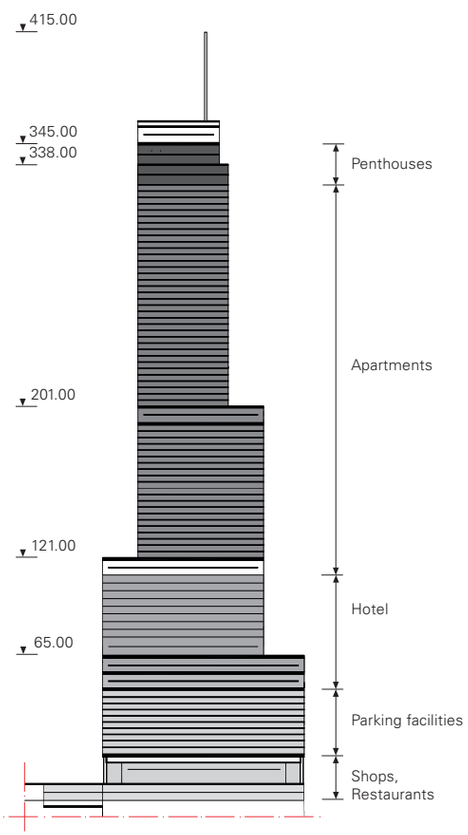
The RCS climbing protection panel secures site personnel at all times against falling and provides reliable protection at great heights against strong winds.

James Payne
Project Superintendent

"All the PERI systems on site are easy to use. They can be quickly adapted to the changing conditions of this large project. The support given by PERI during the formwork planning as well as the logistical efficiency is important to our success."



From the 16th floor onwards, the east and west sides were cladded with the RCS climbing protection panel. In so doing, the building edges of the upper storeys were completely enclosed and moving the slab formwork could be accelerated. Equipped in part with mobile self-climbing devices, the RCS could be climbed crane-independently.



The Regatta Condominium Tower,
Chicago, USA

Paul Treacy
Concrete Superintendent

"Using the PERI climbing protection panel and SKYDECK slab system has allowed us to work safely and extremely efficiently even in high winds."

The Regatta complex is comprised of 44 storeys and reaches a height of 142 m. Around 325 condominium units, with a total of 65,000 m² of living space, offer a magnicent view of the Chicago River, Lake Michigan and the skyline of Chicago. One of the distinctive features of this structure is the curved curtain wall facing the lake.

In order to construct the floors efficiently and safely including at great heights, the contractor decided in favour of the RCS P (P=protection) climbing protection panel. The RCS system completely encloses the working environment and thus minimizes any weather-related delays. At the same time, the productivity rises as site personnel can work in a completely safe and comfortable area.

For this project, mobile climbing units were not used which meant the RCS was lifted with the crane whilst still being guided by rails attached to the building. During the climbing process, the protection panel was safely connected to the building at all times by means of climbing shoes and rails.

Several of the climbing units were additionally equipped with an integrated material platform. The RCS system also provided ideal advertising space which was visible for a long way.

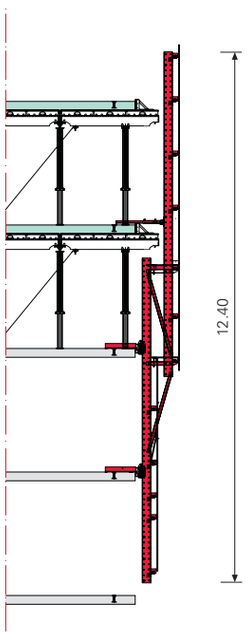
For the construction of the reinforced concrete core, the ACS self-climbing system accelerated all working operations as shuttering, striking and climbing could be carried out with the use of a crane. Wall formwork, slab formwork and the integrated main placing boom moving reliably and efficiently upwards with the ACS system.

QUATTRO column formwork and SKYDECK aluminium slab formwork provide a rational supplement to the PERI formwork concept. With both systems, high productivity could be achieved and, together with with the RCS and ACS climbing systems, fast and safe completion of each individual floor was realized without any problems.

The RCS P climbing protection panel encloses the complete floor and provides site personnel reliable protection against the risk of falling. At the same time, efficient working conditions are guaranteed also during extreme weather conditions and high winds.

The comprehensive PERI formwork concept allowed the contractor to maintain the very tight construction schedule.

Contractor
James McHugh Construction, Chicago
Field Service
PERI Chicago, USA
and PERI Weissenhorn, Germany



Sea Towers
Gdynia, Poland

The Sea Towers highrise complex overlooking the Gulf of Danzig consists of two connected towers with 28 and 36 floors respectively.

Due to the tremendous wind loads, the contractor decided on a safe and crane-independent climbing combination comprising of RCS climbing protection panel and proven ACS self-climbing formwork.

From the fourth floor onwards, the RCS climbing protection panel completely enclosed the slab edges. This meant that site personnel were effectively protected against the risk of falling and strong winds at all times. Naturally, this feeling of safety substantially increased the productivity.

With the RCS rail climbing system, fast and safe climbing could still be carried out even during strong wind conditions because the continuous connection of the scaffold unit to the structure by means of the climbing rail and shoe prevented any drifting. Mobile self-climbing devices moved the RCS units to the next section without the need of a crane.

The hydraulic cylinders have a 5 t lifting capacity and can easily be moved by hand – this minimized the self-climbing technology costs and saved the need for expensive crane operations.

The walls for the stairwells and elevator shafts were formed with the help of the ACS modular construction system. Due to the cramped structural dimensions, the ACS G and ACS P versions, together with the mere twelve centimetre narrow TRIO panel formwork, provided the best solution. Thus it was possible to concrete the slab and wall monolithically in only one operational sequence. This construction method shortened the cycle times and saved on time-consuming reinforcement connections.

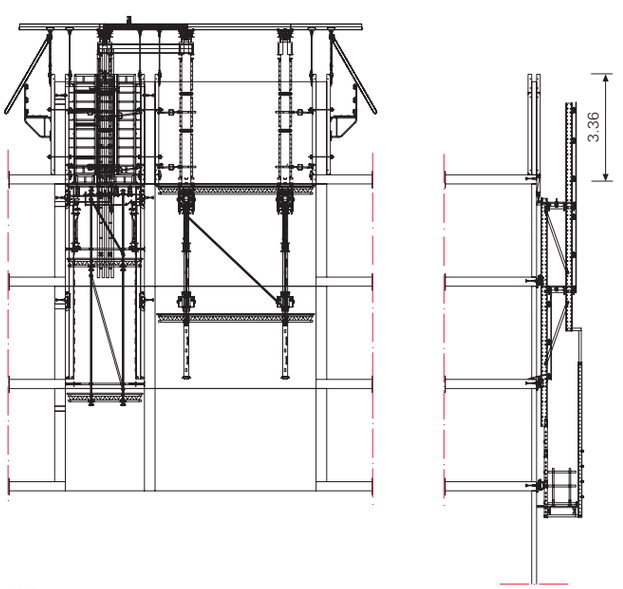
In spite of the complicated and changing building geometry, one floor was completed in only eight days in both towers using the PERI solution.

With the crane-independent PERI ACS self-climbing system, walls and slabs could be concreted in one pour.

The PERI RCS climbing protection panel provided ideal protection for site personnel against falling as well as strong winds which increased the productivity.

Marek Skalski
Site Manager (Concrete Frame), Modzelewski & Rodek

"Through the cooperation with PERI and the professional support they provided, we could finish this complex project before the planned completion date. With the RCS climbing protection panel, work could continue even during difficult weather conditions and mobile climbing hydraulics minimized the required crane time."



Drawing:
Section of ACS G and P on the building core (left) and section of the RCS climbing protection panel (right).

Contractor
Porr (Polska) S.A., Warsaw (GU) Modzelewski & Rodek Sp. z o.o., Warsaw (Concrete Frame)
Field Service
PERI Warsaw, Poland and PERI Weissenhorn, Germany

The 138 m - high complex is situated directly on the harbour front and, on completion, provided around 32,000 m² of residential, office and retail space.

La Tour Granite
Paris La Défense, France

Contractor
VINCI Construction, Paris
Field Service
PERI Meaux, PERI Weissenhorn

Alban Negre
Site Manager

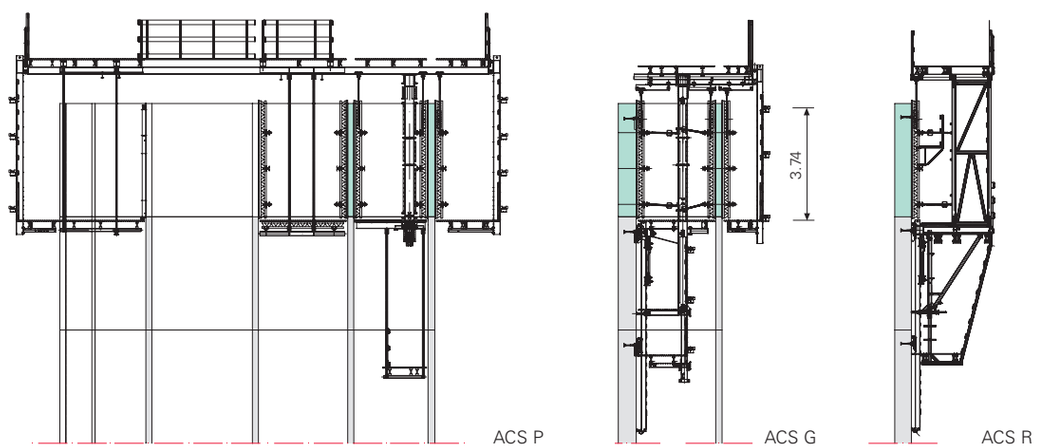
"The ACS system could be easily adapted to the complex building geometry with its numerous openings and offsets. In spite of the different storey designs, we successfully managed to gain time when constructing the standard floors compared to the originally planned 5-day cycles. With ACS, PERI can achieve the impossible. Without this system, we wouldn´t have been able to maintain the schedule."

The geometry of the core walls for this 180 m high office and administration building in the Paris La Défense business district placed great demands on the formwork technology. Virtually no right angles, numerous sections with varying angles, radii and wall breaks on the external walls of the core as well as the internally-positioned elevator shaft walls had to be taken into consideration.
For forming the core´s external walls, PERI engineers decided to use the ACS R and ACS G crane-independent climbing systems. The formwork elements were suspended directly on the formwork scaffold.

This could then be smoothly retracted for cleaning purposes and the climbing procedure, and easily positioned for closing the formwork.

ACS P was used for the walls of the elevator shafts. In the process, two combined 6-fold hydraulic pumps simultaneously controlled twelve climbing devices so that the complete formwork unit could be moved from cycle to cycle at the same time and without jerking. An additional platform unit complete with four climbing devices alowed the placing boom to be lifted accordingly without the need of a crane.

In close cooperation with the customer´s safety inspectors, all entrance and working areas of site personnel were secured through guardrails, sliding hatches, openings for concrete etc., in order to meet the high safety requirements of this prestige project.
Apart from the self-climbing ACS systems, PERI supplied the site with around 800 m² customised VARIO girder wall formwork for the inclined wall areas on the ground floor and 2,200 m² of MINIFLEX slab formwork. Thus, all requirements could be effectively met regarding safety issues and working speeds.



Second Severn Bridge
Bristol, UK

Construction of the Second Severn Crossing between England and Wales demanded the utmost of people and materials.
Two 149 m high concrete pylons were constructed in-situ to a tight schedule.

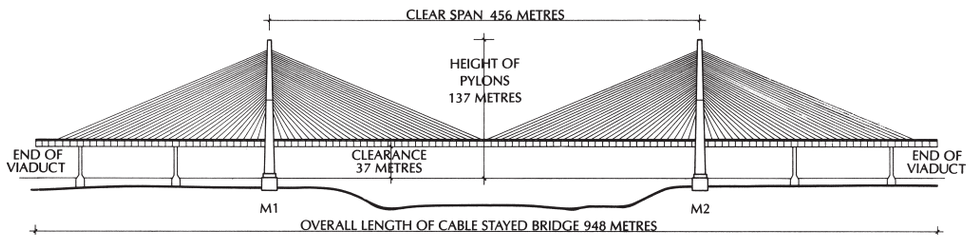
Concreting heights varied from 3.70 m to 4.50 m and the cross-sections ranged from 5.50 m to 10 m. Due to this, PERI´s solution consisted of two sets of formwork in order to avoid having to cut it back as the pylon tapered. This design also saved time as the first set of formwork was already starting on the second pylon while the second, narrower set was completing the first.

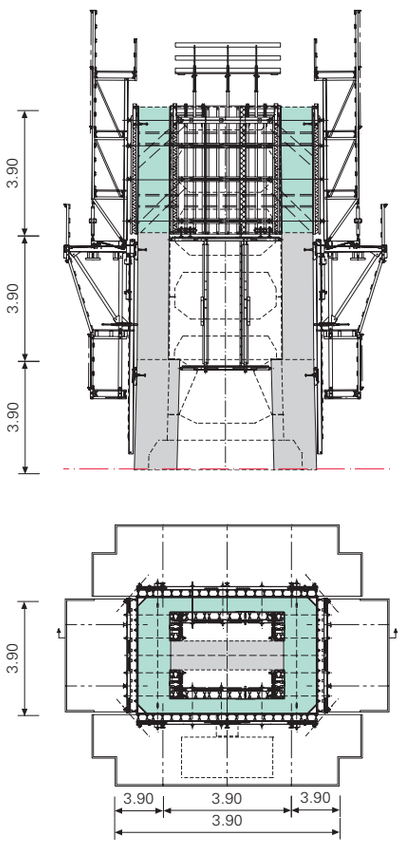
An important requirement was that the system had to be sufficiently robust for offshore use - not only the scaffold brackets but also the complete climbing system. Regarding this type of construction method, PERI could rely on proven self-climbing technology it had already developed for highrise applications.

All components were designed to allow all site supply requirements - power, water and compressed air - to be carried on the scaffold units in addition to the high live loads. Apart from the concreting platform, six other platforms for operating the formwork, installing reinforcement in advance and alighting were required. Each platform unit carried a formwork surface area of 25 m² and could be retracted 70 cm.

The asymmetrical scaffold units were climbed only one day after concreting had taken place. In spite of the uneven load distribution on the brackets (with ratios of up to 1:4), the platforms smoothly slid upwards in 64 cm increments. The hydraulic control system automatically checked that this operation did not exceed the permissible loads and ensured the synchronisation.

PERI ACS has been designed for wind speeds of up to 180 km/h and climbing can take place at wind speeds of up to 80 km/h.





After being used for concreting the pyons, the ACS climbing scaffolds were modified for doing the cable work. The self-climbing platforms allowed access from the lift to the cable inlets. An electrical winch with a safe working load of 1.0 t was mounted on the main platform to help with the cabling work.

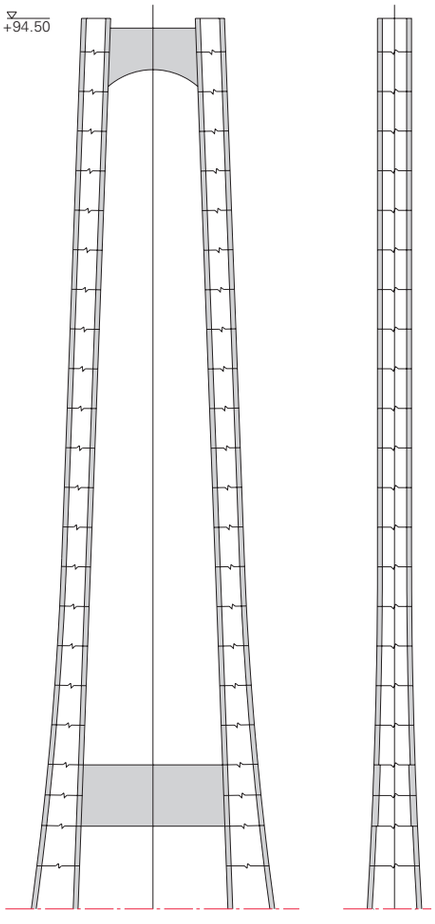
ACS climbing scaffold and formwork for the 32nd concreting section (top cross beam ready for lifting) plus CB 240 scaffold units which provide access to the brackets with cable winches and pre-tensioning niches for the top cross beam.

Joe Leydon (left) and Willie Reilly
Site Managers

Contractor
John Laing plc, London and GTM-Entrepose, Paris Consortium
Field Service
PERI Great Britain, PERI Technical Office and Export Division, Weissenhorn

Four identical formwork sets of PERI ACS (Automatic Climbing System) in connection with PERI VARIO girder wall formwork were used for constructing the two pylons, North Pier and South Pier, of the Storda Bru.

Longitudinal and cross-sections of the North Pier: 23 concreting sections lead to the final height of 94.50 m



Storda Bru
Hardangerfjord, Norway

With a length of 1,076 m, the Storda Bru is the second longest suspension bridge in Norway. It is part of a construction project that links three islands and their population of 33,000 people in the Hardanger Fjord, not far from the town of Bergen.

The eye-catching feature of the construction is two pylons of 94.50 m and 86.50 m in height that were to be formed 667 m apart. The pylons consist of double-box piers that increasingly taper towards the top, whilst the opposite side runs straight up with a constant inclination of 2.097° to the vertical. The ends have a uniform taper from an initial width of 5.60 m to 3.50 m at a height of 42.22 m, after which they remain constant.

External formwork: VARIO girder wall formwork on four ACS climbing units with two brackets each. These were adjusted for the tapering pier sections by cutting back the formwork elements for each concreting cycle. All levels could be hydraulically climbed together. The large lifting cylinders of the climbing devices provided smooth, jerk-free operations and, with 0.5 m/min, fast lifting times were guaranteed.

Internal formwork: two-part VARIO on internal platforms with gravity pivot plates. On the two ends, the formwork panels were adjusted to the tapering geometry from lifts 1 to 11 by cutting them back. Longitudinal panels only had to be adjusted on one side. Climbing was carried out with the crane.

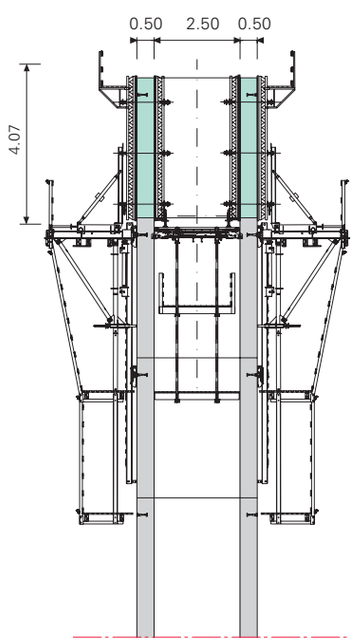
The convincing formwork concept was also mirrored in the fast construction time. Daily concreting allowed six concreting cycles, with a standard height of 4.07 m, to be reliably completed on a weekly basis.

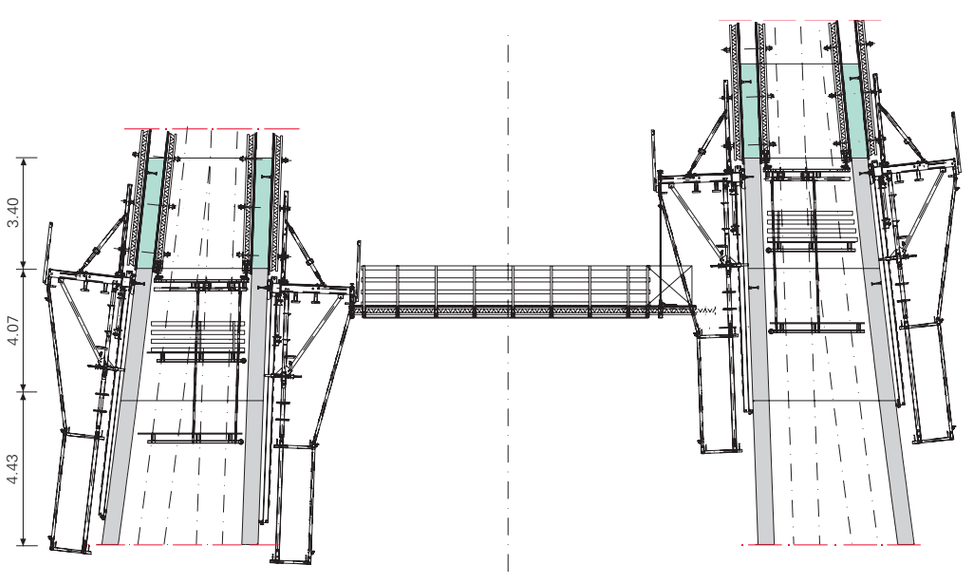
PERI ACS has a high degree of safety: the design of this system ensures the climbing unit is firmly connected with the structure during all operational conditions, and the patented anchor system with the M30/DW 20 climbing cone provides reliable load transfer.

Four working levels: the concreting platform, the formwork shuttering and striking level, the platform for the hydraulic and control systems, and the finishing platform for removing the climbing shoes and anchor cones, ensured that the personnel could move around safely at all times and for any operation.

The safely accessible connecting bridge saved on having to install a complete lift system. It could always be maintained in a horizontal position by means of an electric chain block, even when there were differences in the climbing levels of both pylon sides.

Contractor
NCC Eeg-Henriksen, Anlegg
Field Service
PERI Norge A.S. Osterås and Weissenhorn





Samchonpo Bridge
Deabang-Dong, Korea

The crossbeams were shuttered with VARIO girder wall formwork on falsework provided by the contractor.

Contractor
Daelim Industrial Co. Ltd., Seoul, Korea; Hyo Hyung Construction Co. Ltd., Incheon, Korea
Field Service
PERI Korea, Seoul and Weissenhorn

Byung-ki Yoon
Project Manager

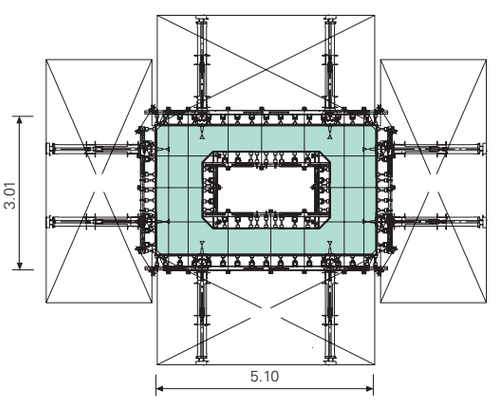
"We decided in favour of PERI VARIO and ACS because we were very impressed by the formwork technology as well as the comprehensive operational safety features, even when subjected to high wind speeds."

The Samchonpo Bridge links the Daebang-Dong district on the island of Mogae with the Sachon-Si area on the mainland. The structure carries a two-lane highway over an approximately 500 m wide channel.

The two 92 m high pylons were climbed with ACS and accommodate the triple span suspension bridge's cables which are arranged like the strings of a harp.

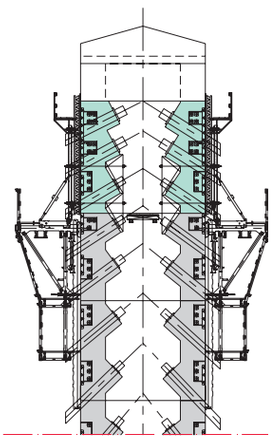
On each of the four pylon legs, PERI used four ACS R self-climbing units which were controlled by means of two 4-fold hydraulic pumps. The VARIO formwork was designed to be cut back between lifts to suit the changing cross-sections. Cable sleeves projecting 60 cm over the top edge of the concrete had to be installed above the second cross-beam. To accommodate these protruding tubes, the VARIO formwork was split into two elements and closed with fillers. The climbing platforms were also modified which then made it possible to climb past the tubes.

PERI engineers incorporated a special landing platform to make the climbing scaffold's platforms easily accessible for site personnel from the elevator. This avoided having to specially modify the means of access to deal with the discrepancy between the vertical direction of the elevators and inclined pylon legs.

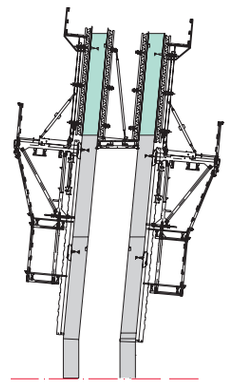


Formwork and working platforms, levels 5-6

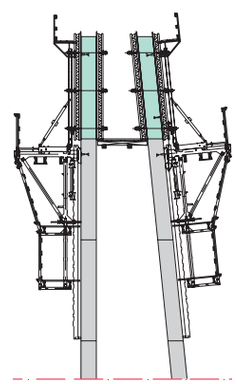
Artist´s impression of the finished bridge: 30 m of clear headroom allows the passage of ships of up to 5,000 t.



Section above the second cross-beam. ACS with modified platforms climbs unhindered past the cable sleeves that accommodate the stay cables.



Pylon legs between the first and second cross-beams: parallel inclination of the formwork and climbing units for the constant cross-section of 5.00 x 2.80 m.



Pylon legs taper on the inside up to the first cross-beam from 6.20 x 5.00 m to 5.00 x 2.80 m.

Arthur Ravenel Jr. Bridge,
Charleston, USA

Built on two man-made islands in the Cooper River, the pylons steadily increased in height in weekly cycles using PERI ACS self-climbing technology and VARIO GT 24 girder wall formwork. Two 50 m long PERI special constructions served as catwalks which allowed easy and time-saving access for site personnel from pylon to pylon.

Arthur Ravenel Jr. Bridge
Charleston, USA

PERI ACS lifts four working levels together with the formwork from cycle to cycle without the use of a crane: concreting platform, shuttering and striking level, platform for hydraulics and climbing operations along with the finishing platform used to disassemble the climbing shoes and anchor cones.

Peo Halvarsson
Senior Project Manager

"Previous experience and an excellent working relationship with the PERI engineers made our decision regarding the choice of formwork supplier an easy one. The PERI solution provided us with a formwork system with which we could work quickly and produce quality results at the same time!"

Contractor
Consortium comprised of Tidewater/Skanska USA Inc. and HBG Constructors Inc./Flatiron Structures Company

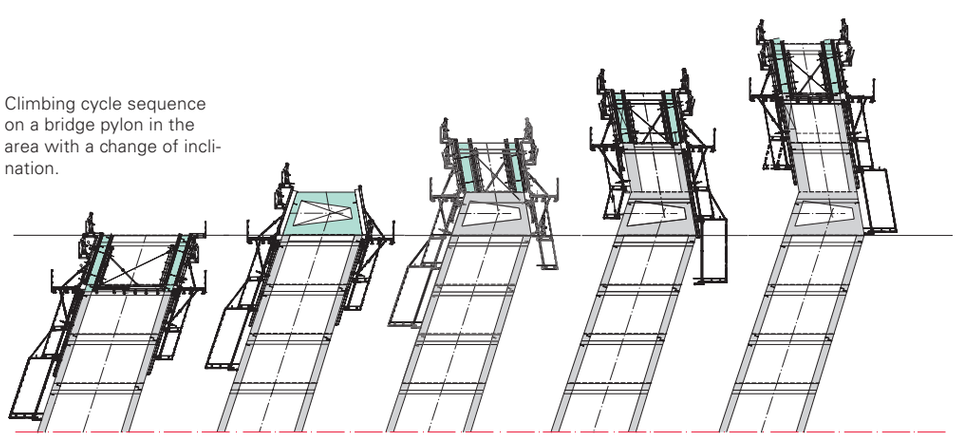
Field Service
PERI Weissenhorn and PERI USA, Baltimore

Two 175 m high piers, at a distance of 472 m from each other, take the loads of this cable stay construction, which connects both sides of the Cooper River.
The short construction time together with tough logistical requirements (all materials had to be transported to both piers using barges) and the necessity to save on crane capacity meant that the use of a self-climbing formwork system was essential.

PERI engineers designed an extremely efficient formwork concept containing detailed pre-determined working speeds. These were maintained by the construction crews resulting in a high degree of productivity. The high requirements placed on the concrete surfaces together with the dimensional accuracy were fully met using PERI ACS and VARIO GT 24 girder wall formwork. The scaffolding units remained permanently connected to the structure even during climbing which ensured high levels of safety throughout. All wind loads were taken into consideration during the planning phase.

Around 1,000 m² of VARIO GT 24 girder wall formwork was used as well as eight ACS V platforms for the inclined pier sections and eight ACS R platforms for the sloped areas.
On the lower half of the piers, up to the change in inclination, one concreting section of 4.15 m was finished per week. Due to the simplified reinforcement arrangement and smaller construction geometry, concreting took place every four to five days in the upper area and contractors were able to reduce the scheduled pour sequence from seven to five days.

Climbing cycle sequence on a bridge pylon in the area with a change of inclination.



The new bridge has created optimal conditions for meeting today's road and waterway traffic requirements. The road itself lies 61 m above the surface of the river which allows the passage of large ships.

Sucharski Bridge
Gdansk, Poland

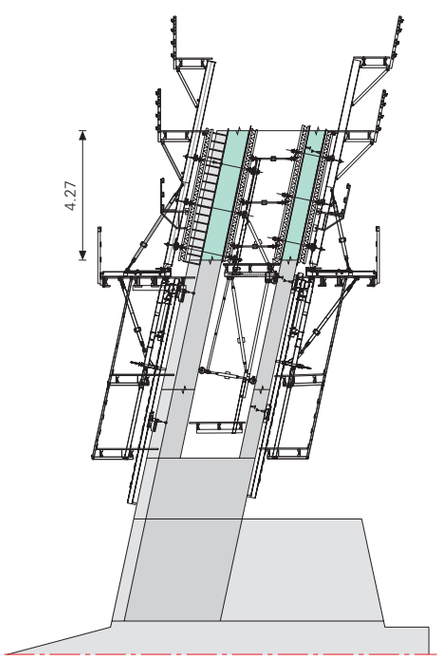
After the Swietokrzyski Bridge in Warsaw, this structure is the second cable-stayed bridge in Poland. The 381 m long and 20.30 m wide suspension bridge has a span of 230 metres. The 97 m high pylon is visible from a large distance and resembles an upside-down letter Y. The two pylon legs, inclined at an angle of 78°, meet at a height of 57 metres to form a vertical shaft.

PERI divided the angled pylon legs into 13 concreting cycles, with twelve cycles for the shaft. Climbing was done crane-independently with the ACS system. In order to ensure a cost-effective completion of the project, the contractor was optimally equipped with flexible VARIO GT 24 girder wall formwork elements as well as fast TRIO formwork for the internal vertical shaft. The use of shortened VARIO components for the inside of the pylon allowed easy and accurate adjustment to the cross-section tapering from 5.00 to 3.60 m.

The selected climbing and formwork solutions were decisive factors in the optimisation of the construction progress. Along with a high degree of accuracy, a faultless concrete surface finish could be achieved.

Through the new bridge, the infrastructure in the region around Gdansk – located on the Baltic Sea – has been significantly improved.

With 100 kN lifting force per bracket, the ACS climbing system has numerous safety reserves. The ACS 100 climbing unit with the patented rack system works automatically, safely and without any jerky movements. It has a climbing speed of 0.5 m/min.



On the inside and outside of the angled pylon legs, VARIO GT 24 elements on ACS brackets were climbed crane-independently. Six working levels provided ample space for construction crews. The concreting cycle height was 4.27 m.

Both pylon legs were climbed simultaneously. I spite of the inclination, working platforms at all levels (concreting, main, climbing and finishing) are adjusted continuously in a horizontal position, which means construction crews can work more efficiently.

While climbing continues at the top, assembly measures for the bridge cables are taking place below. The working levels, consisting of PERI UP Rosett scaffolding units, rest safely on KG climbing brackets.

Wlodzimierz Bielski
Site Manager

"With ACS, we could work safely and comfortably. The formwork adapted excellently to the changing cross-sections and inclination which enabled us to achieve high productivity. "

Contractor
Warbud S. A., Warsaw
Field Service
PERI Poland, Warsaw, Gdansk and PERI Weissenhorn

Motorway Viaduct, Millau, France

On 4 July 2003, the French contractors Eiffage TP reached a height of 183.415 m on the P2 pier, thus setting a new world record for the highest bridge pier.

However, another 15 concreting sections using ACS self-climbing technology were required to reach the final height of 245 m.

Motorway Bridge
Millau, France

This very spectacular bridge project in the south of France was designed by the English architect, Sir Norman Foster. A total of 7 reinforced concrete pylons of heights between 78 and 245 metres were to be constructed to support the steel superstructure and the steel pylons carrying the stay cables.

The Viaduc de Millau is part of the motorway connection between Paris and the Mediterranean area of southern France. The French government granted usage rights for the structure over the next 75 years to the Eiffage construction group and, in return, a warranty for 120 years was agreed on between the two parties.

PERI's formwork technology provided a convincing solution. Using this concept, the contractor was able to reach a regular 3-day cycle for one concreting section within a very short space of time.

PERI's formwork and shoring concept was based on customised steel formwork, which was designed to handle the large areas to be formed as well as producing high quality concrete surface finishes. All external formwork climbed hydraulically and crane-independently from cycle to cycle using ACS self-climbing scaffold. The internal formwork was designed to be lifted by crane.

In order to ensure that the work was carried out on schedule, PERI delivered various formwork and scaffolding systems to the site. Their use was strictly in accordance with the construction schedule on the various piers, which meant use on either different piers or combined together on one.

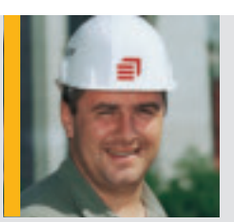
Altogether, around 6,500 m² of formwork was used for the double and single piers. This climbed hydraulically on 196 ACS R brackets as well as being crane-climbed using 96 SKSF 240 brackets. Twelve specially designed scaffold modules were used for the formworking operations.
The complicated shape of the structure required adapting existing formwork or producing new elements for each concreting section. This was achieved through special 142 mm compensation panels, with additional filler elements for each cycle and using telescopic steel walers in the areas of compensation. The formwork was designed to handle up to 100 kN/m² of concrete pressure.

Jean-Pierre Martin
Senior Project Manager

"For this type of construction, the right choice of formwork and climbing systems is the key to success. PERI has proved itself to be an extremely competent partner and the company´s huge project experience, together with its tremendous commitment to the project, has contributed greatly to the fact that we are ahead of schedule!"

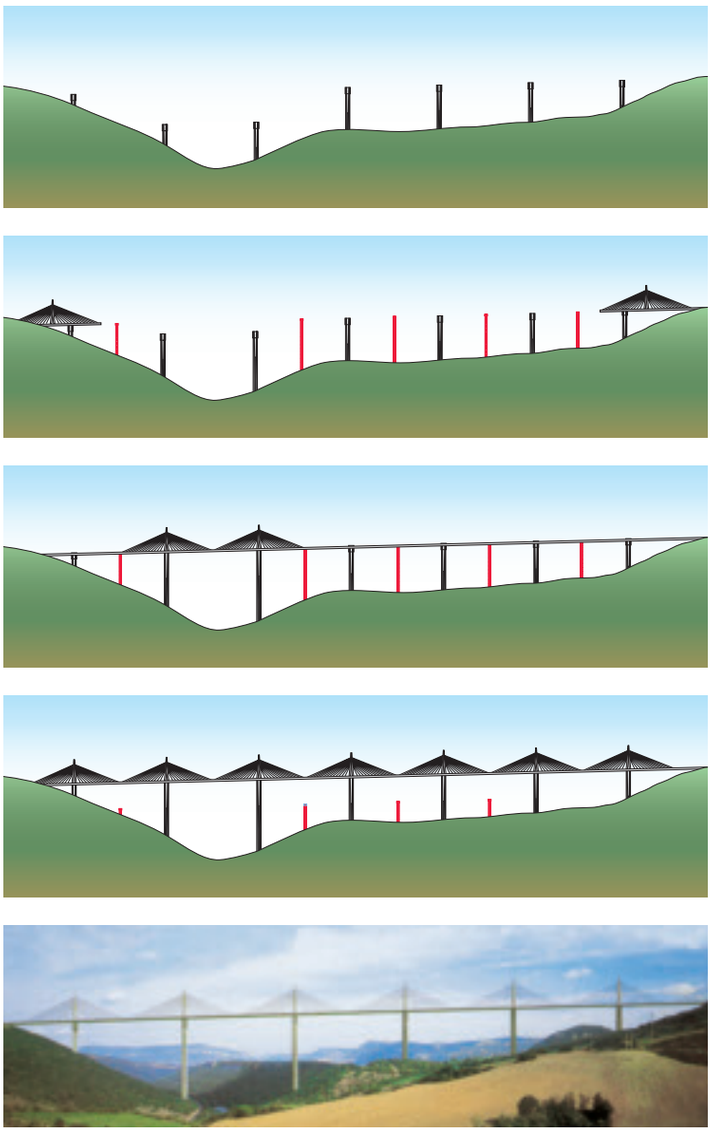
Marc André
Project Manager

"PERI ACS is a highly effective self-climbing system and the Eiffage crews felt very comfortable with using it. The customised steel formwork is also a good solution which ensured we got the required concrete surface quality."



Phillippe Blondeau
Quality Assurance

"The results we achieved with the ACS self-climbing formwork have completely fulfilled our expectations. Taking into account the extremely complex construction geometry, we could produce a concrete surface of the highest quality."

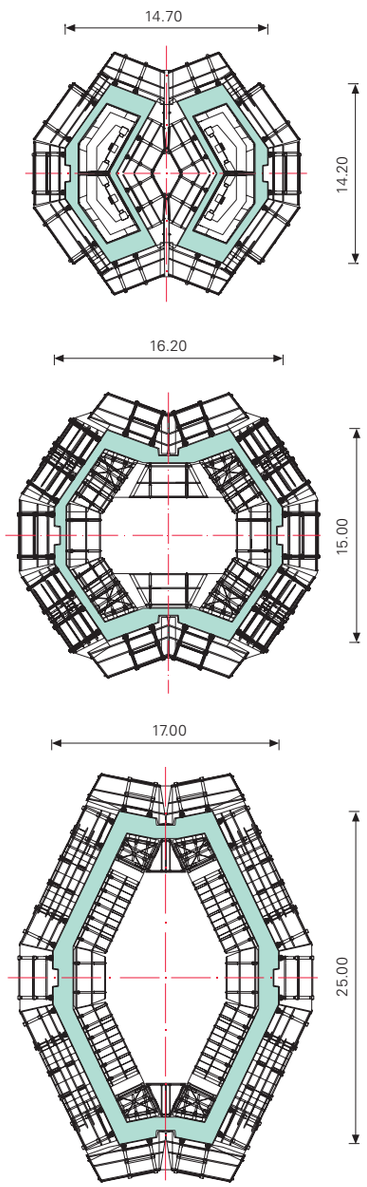


The steel superstructure was launched at the same time as the erection of the concrete piers. Temporary piers made of steel were positioned in between the concrete piers under construction in order to reduce the spans during launching. The steel pylons on the superstructure and the cable stay construction were then mounted one after the other.

PERI ACS provides a high level of safety even during high wind speeds. The units always remain connected to the structure also when being climbed.

Contractor
EIFFAGE TP, Neuilly-sur-Marne, France
Field Service
PERI Germany, Weissenhorn and France, Meaux

Motorway Bridge
Millau, France



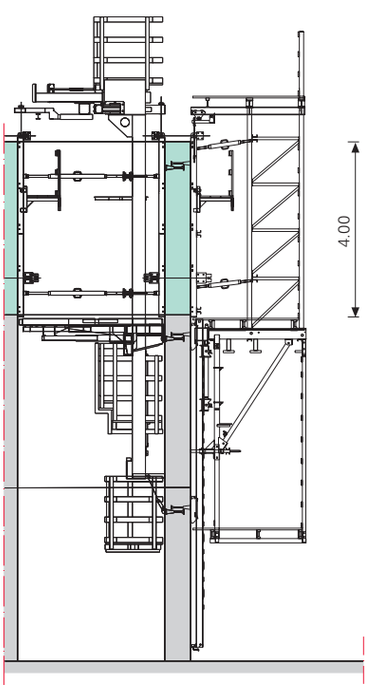
Complicated pier geometry
From the foundation slabs, the piers taper upwards from 27 to 14 metres in the first section. This is followed by a Y-shaped segment where the single piers split into double box piers. At 90 metres below the road surface, the double box piers begin to taper upwards from 14.40 m to 11.13 m at the top. This means the cross-section dimensions of the piers change from cycle to cycle and requires constant formwork adjustment.

At a height of 90 metres under the road, the single piers divide into double box piers. The tapering of the cross-sections requires adjustment of the formwork for each pour.

The PERI solution: only one anchor position in the concrete (2nd position above the concrete joint) which reduced shuttering times and resulted in a 50% reduction in anchor positions. In spite of the difficult joint and anchor configuration, the customised steel formwork produced an excellent surface finish.

The completed "construction of the century" after being opened for traffic in 2004. The 2,460 metre cable stayed bridge carries the road superstructure at heights of up to 245 metres across the valley. The tops of the steel pylons reach heights of 345 metres.

The working platforms form a platform around the pier cross-section. In the absence of any leading edges, this means construction crews can work effectively and in complete safety at all heights.



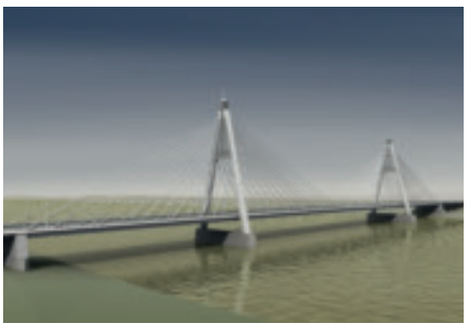
Standard section of a double pier with customised internal scaffold along with ACS R on the outside.

M0 North Danube Bridge
Budapest, Hungary

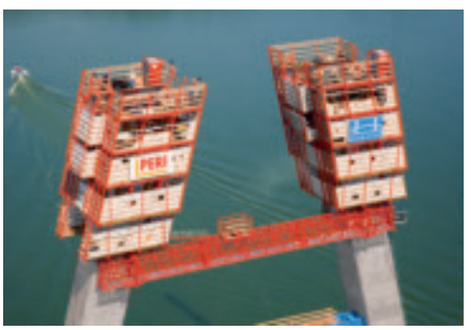
The overall height of the pylons on the Danube Bridge is 100 metres. Up to the concrete tip, a total of 29 casting segments with variable concreting heights between 2.55 m and 4.07 m had to be mastered.

The pylon supporting members are inclined towards to the centre of the roadway at an angle of under 13.3° and have a range of different cross-sections. Beginning with external dimensions of 5.00 m x 4.11 m on the bottom plate, the members taper up to 3.50 m x 4.11 m in the area of the cable stay connections. The internal dimensions are also reduced in the longitudinal direction by 0.80 m.

For the forward and reverse-inclined external walls, PERI ACS V was used as climbing scaffold. The advantage: due to the continuously adjustable brackets, the working platforms are always in horizontal position which means work can be carried out safely and ergonomically. For the remaining external wall surfaces, ACS R brackets were selected, which proved their suitability once again on this construction site for laterally-inclined climbing. Guardrails and weather-resistant sheeting were installed to totally enclose the five working levels, positioned one on top of each other, resulting in optimal working safety conditions and providing ideal protection against the weather.

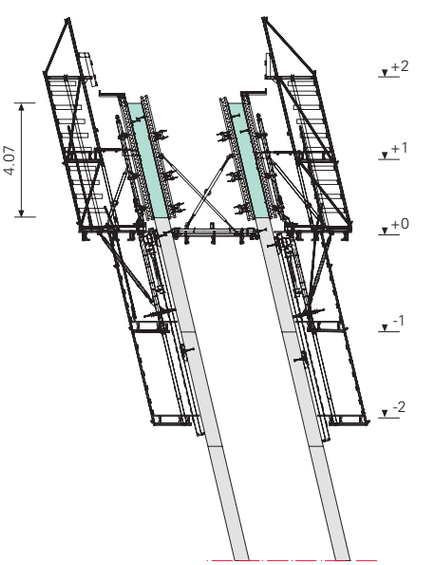


This new bridge construction in Budapest is part of the northern section of the M0 motorway. The impressive bridge design with two highly visible reinforced concrete pylons will connect the M3 motorway with the main artery road 11 and leads the new route safely across the Danube river.



Due to the catwalk between the two pylon legs, only one elevator was required and greatly reduced the amount of walking for site personnel. The catwalk can always be positioned horizontally regardless of the angle of the climbing formwork units.

Level 1 with eight hydraulically-operated ACS climbing devices. The supply unit guarantees the synchronous climbing procedure. The working level provides generously-sized working areas for personnel, tools and equipment.

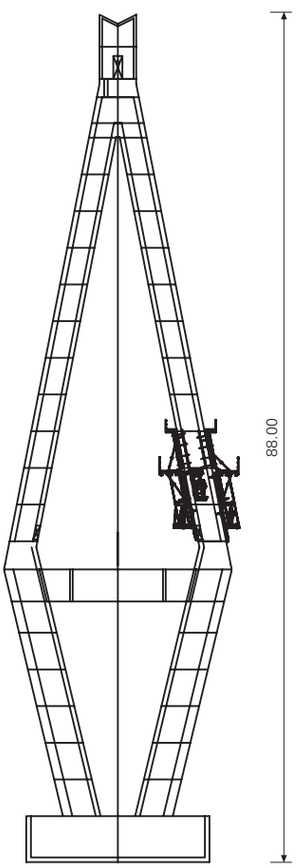


Main Contractor
M0 North Danube-Bridge Consortium Hídépítő Zrt.
STRABAG Zrt.
Field Service
PERI Germany and Hungary

"The safety and reliability of the PERI ACS self-climbing formwork is of particular importance in such a project. With help of the VARIO customised formwork, we could complete the varying cross-sections of the pylons on schedule and with great accuracy."

Császár Csaba
Technical Director
(Pylon 6)

Geo Geum Bridges
Nokdong, Korea



Two cable-stayed bridges now connect the island of Geo Geum to the mainland, via Sorok Island, in the south-eastern part of Korea. All four bridge pylons are diamond-shaped – something seen for the first time in Korea. For the erection of the pylons for both bridge constructions, PERI climbing technology provided the most cost-effective solution. Due to the off-shore location, very high wind loads (typhoon region) along with limited storage and assembly areas had to be taken into consideration in addition to the concreting loads.

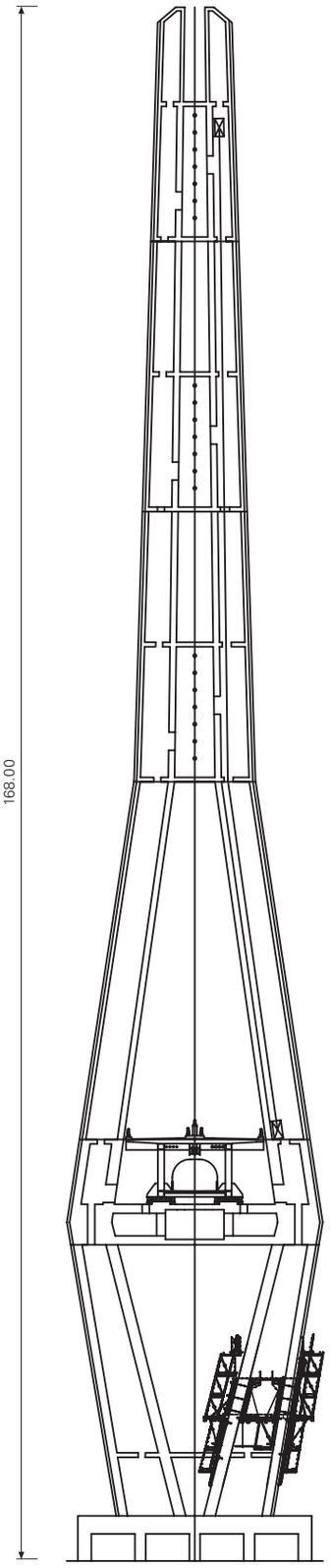
Already in a first construction phase, two pylons were erected for the Geo Geum I Bridge (also known as the Sorok Bridge), each with a height of 88 m. The 1,160 m long structure closed the gap between the small island of Sorok and the mainland, just north of the town of Nokdong. The climbing formwork solution consisted of a cost-effective combination of crane and self-climbing technology with the VARIO GT 24 girder wall formwork system.

Geo Geum I
Contractor
Daelim Ind. Co., Seoul (Main Contractor), Jaehyun Engineering & Construction Co. (Sub-Contractor)
Field Service
PERI Seoul, Korea

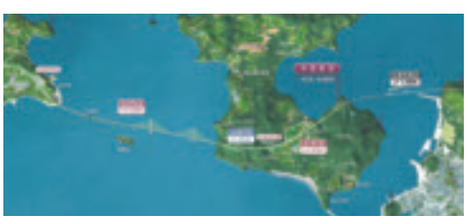
Geo Geum I:
For forming and concreting the cross beams, the PERI steel framework construction transferred the loads reliably and safely into the structure.

Kang Eung Beom
Site Manager
Geo Geum II,
Hyundai

"Due to the special form of the pylons, the ACS self-climbing formwork was our only alternative. This meant the inclined structures could be safely built without any problems, as well as resulting in over a 30% saving in labour costs. The support provided by PERI was also excellent. For me, PERI ACS is the most reliable self-climbing system available anywhere."



The 2,028 m long Geo Geum II Bridge connects the islands of Sorok and Geo Geum. In weekly cycles, the 168 metre high pylons were quickly and efficiently constructed using ACS self-climbing formwork with concreting cycle heights of four metres. The climbing units allowed the contractors to easily adapt the formwork to suit the variable cross-sections with wall thicknesses between 1.25 and 1.60 m, and without the need of any time-consuming assembly work.



Geo Geum II
Contractor
Hyundai Engineering & Construction Co., Seoul (Main Contractor)
VSL, Seoul (Sub-Contractor)
Field Service
PERI Seoul, Korea

The four pylons of the spectacular Mega Bridge in Bangkok dominate the city skyline up to a height of 173 m. From the beginning onwards, PERI ACS self-climbing technology ensured fast construction progress.

Mega Bridge, Industrial Ring Road
Bangkok, Thailand

Due to its favourable geographical situation, Bangkok is one of the leading economic powerhouses in South-East Asia as well as an important centre for trade with the west. Various measures for the avoidance and alleviation of the sometimes catastrophic traffic congestion are gradually being implemented.

The most spectacular project was the so-called Mega Bridge which is part of 13 km long Industrial Ring Road (IRR) located in Bangkok´s main industrial area. Here, the Chao Phraya river forms a large meandering loop which means the bridge crosses the river twice in a north-south direction. On the strip of land in the middle, there is a freeway junction constructed at a height of over 50 m allowing a free flow of traffic to the west.

The bridge construction project was comprised of two striking cable-stayed bridges with lengths of 702 m and 582 m respectively. Both bridges, with spans of 326 m and 398 m, are supported in each case by two impressive pylons with heights of 173 m and 164 m.

Contractors
TNNS Joint Venture
Taisei Construction, Japan
Nishimatsu Construction, Japan
NKK Corporation, Japan
Sino-Thai Engineering + Construction, Thailand
Field Service
PERI HORY, Singapore and PERI Weissenhorn, Germany

The PERI formwork solution allowed efficient construction of the complicated pylon geometry with its complex three-dimensional intersections due to forward and reverse inclinations as well as tapering cross-sections with chamfered edges.

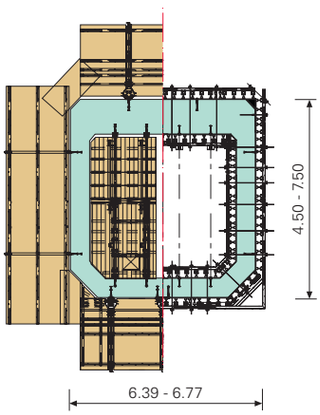
Akira Mihashi
Project Manager,
Hirobumi Kono
Site Manager

"The PERI formwork solution contributed a substantial part for the successful realization of this project. The formwork adapted superbly to the changing cross-sections and different inclinations. A high work-rate was achieved through the safe and good working conditions created by the PERI ACS self-climbing formwork."

All four pylons had to be constructed simultaneously. Complicated three-dimensional intersections through forward and reverse inclinations on the complicated pylon geometry had to be taken into consideration. Furthermore, the around 50 cm per concreting section tapering cross-sections, along with chamfered edges on the inside and outside, were also to be included in the planning requirements.

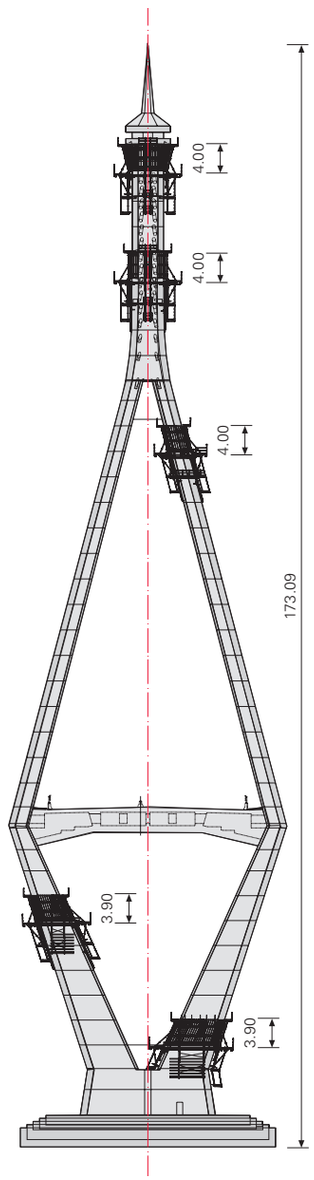
The final formwork solution using the crane-independent self-climbing technology, PERI ACS (Automatic Climbing System) and VARIO GT 24 girder wall formwork was easily and safely implemented on the construction site. The formwork and climbing system could be used for all standard concreting sections without having to undergo any modifications on the ground. The inevitable adjustment work to the VARIO caused by the changing cross-sections was carried out throughout from the integrated platforms. Even during the difficult transition from the lower to the upper areas of the pylons (Lower and Upper Leg), the platforms continued to be used without requiring any substantial alterations.

Only with the changeover to the vertical sections (stem) – concreted up to heights of 158 m – were fundamental modifications necessary on the ACS platforms. Here, structure-related details and openings for the cables had to be taken into consideration.



Section with ACS platforms (left) and VARIO formwork (right).

Climbing was done hydraulically without the need of a crane and the around four metre high segments were concreted in regular weekly cycles.



The pylon was divided into three sections (Lower Leg, Upper Leg and Stem) with complicated transition areas. The continuously adjustable console brackets of the ACS V always ensured horizontally-positioned platforms resulting in safe and ergonomic working conditions.

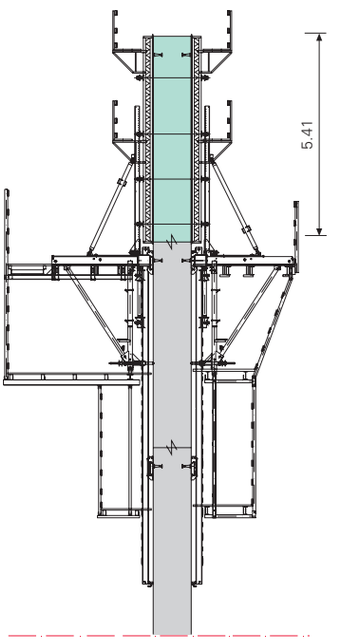
Torre Vasco da Gama
Lisbon, Portugal

With the EXPO ‘98 World´s Fair, Portugal celebrated 500 years of Portuguese discoveries, in particular that of India by Vasco da Gama.
The observation tower named after him is in the form of a stylised sailing boat and provides a clear view over the 330 ha exhibition site.

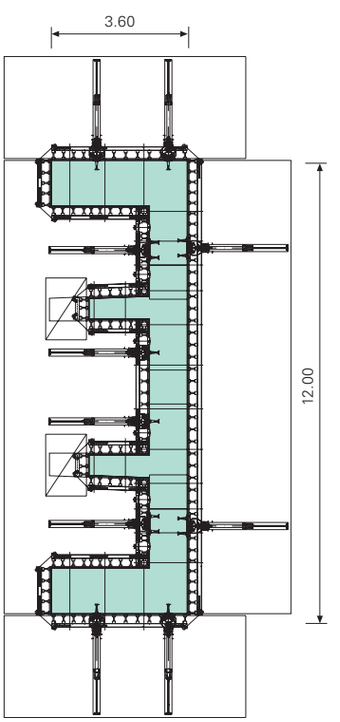
The mast of the sailing boat - a 122 m high reinforced concrete tower - was constructed using ACS self-climbing formwork and contains three elevators.

The climbing procedure for each concreting section was carried out in two steps: firstly, three platforms - two 6 m and one 12 m long - were lifted simultaneously together with 110 m² of VARIO GT 24. This was followed by the 12.00 m long E-shaped special platform which carried 134 m² of VARIO wall formwork.

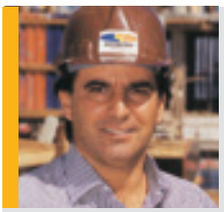
Architectural concrete requirements consisted of neatly-arranged tie points as well as horizontal transverse joints at regular spacings of 1.80 m.



Contractor
SOCONSTROI S.A.,
Miraflores / Algés
Field Service
PERI Portugal, Lisbon
and PERI Weissenhorn



With only four climbing platforms, the complete core was safely enclosed on all sides.



Luís Ferreira
Project Director

"The crane-independent climbing of the 5.70 m high VARIO elements combined with a high level of safety even during high wind speeds, were crucial factors in our decision to use ACS."

Power Station Chimney
Piacenza, Italy

In order to boost electricity supplies, the town of Piacenza invested in a power station plant that produces energy by burning waste products. The filtered exhaust gases are discharged through a 65 m high chimney which was constructed with in-situ reinforced concrete.
With an external diameter of 4.90 m and wall thickness of 25 cm, a high quality architectural concrete surface was created which is treated only with a final coat of paint.

PERI convinced the construction consortium with its formwork concept based on the crane-independent ACS G self-climbing system. G stands for gallows and provides site personnel with a generous freedom of movement along with free access to the working levels and climbing scaffold as well as providing a high level of safety.

After the initial fortnightly climbing cycles, working cycles could be further reduced thus enabling the completion of three concreting cycles per week.

Contractor
CPL – Consorzio Piacentino Lavori: Ceap Srl, Piacenza; cooperativa Val d'Arda Srl, Fiorenziola and Cogni SpA, Piacenza
Field Service
PERI Italy, Basiano, Italy and PERI Weissenhorn

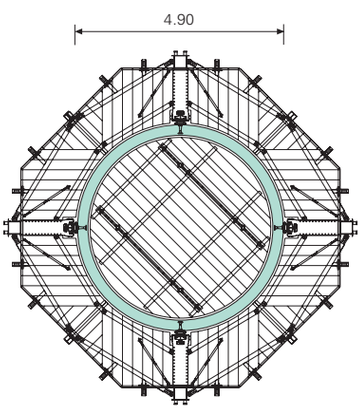
For the design of the self-climbing scaffold, the advantages of the ACS construction kit could be fully exploited: over 80% of the materials consisted of rentable standard components.

Giovanni Mori
General Foreman

"It was a good decision to use ACS on this project. Construction progress with the ACS was so fast that we didn´t need any uneconomical night shifts."

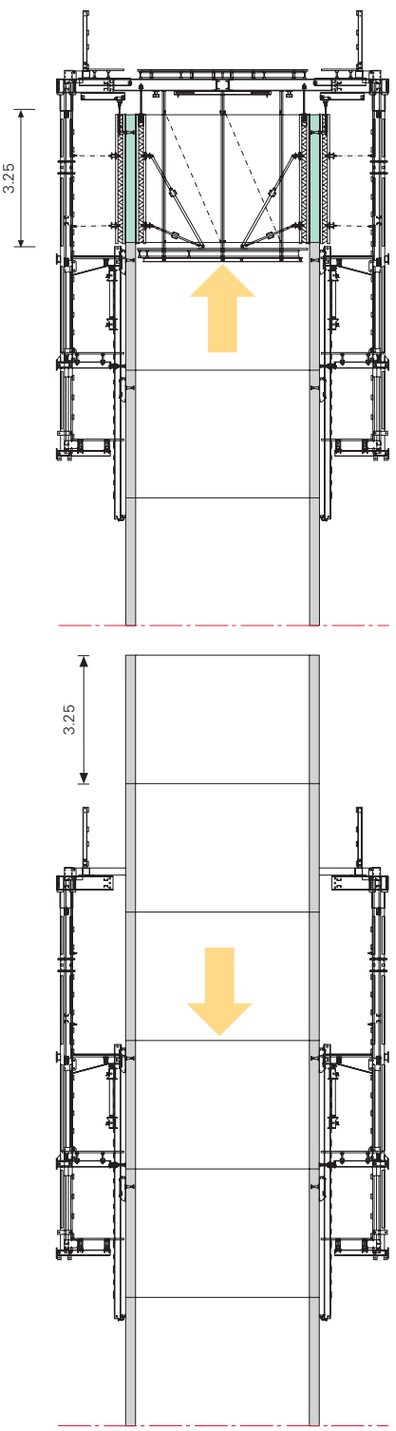
3.30 m high VARIO girder wall elements internally and externally were tightly coupled using VRK couplings. Special circular walings provided the exact shape required.

Internal formwork and internal platforms are connected with the external climbing units via the gallows of the ACS G and can be lifted hydraulically together to the next casting segment.

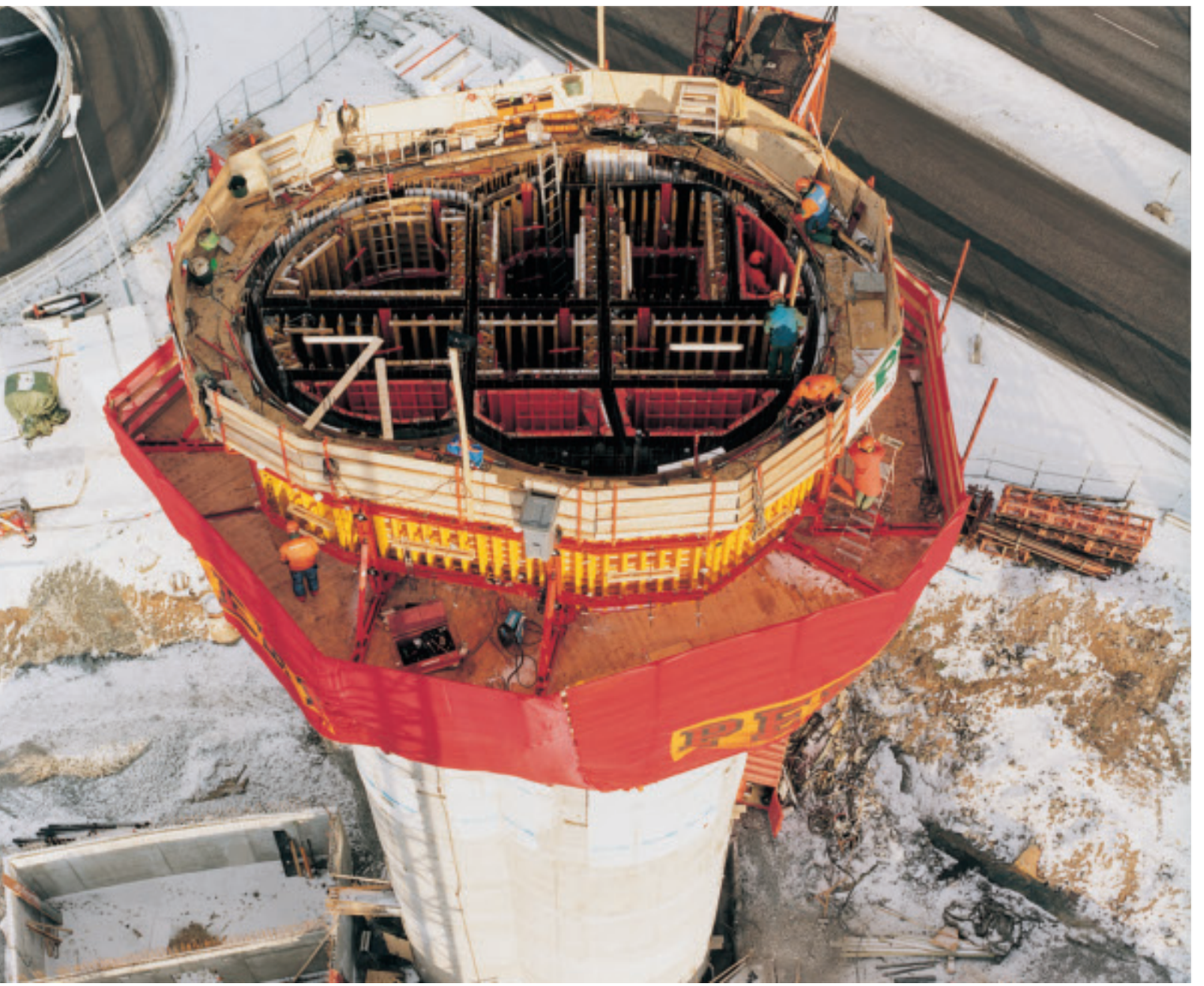


Layout with overview of the platforms.

Formwork and upper main beams have been disassembled. This is how the ACS system climbs down the finished structure. The system provides a safe working platform on all sides for the painting work. This avoided the chimney being completely scaffolded again.



Arlanda Airport Control Tower
Stockholm, Sweden



Contractor
PEAB, Uppsala, Sweden
Field Service
PERI Sweden, Huddinge and PERI Weissenhorn

PERI VARIO girder wall formwork on the outside and for the large shafts; steel formwork on the inside for the small shafts. The external formwork was divided into four elements which could be retracted 70 cm on the ACS carriage for climbing, cleaning and reinforcement work.

Ingemar Jonasson
Site Manager

"The fact that PERI´s automatic climbing formwork had already proved its reliability on various Swedish projects such as the Höga Kusten Bron, the Fatburshöjden Project and the Uddevalla Bron, made us decide in favour of this manufacturer."

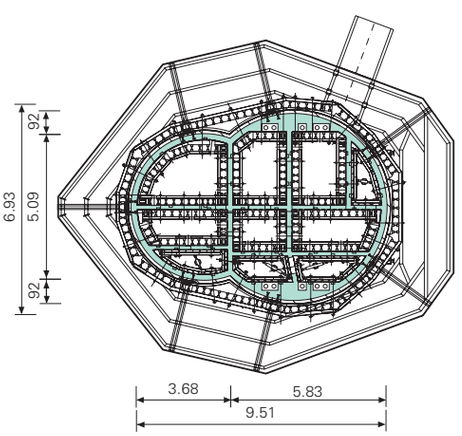
In order to accommodate the increasing number of passengers, the capacity of Europe´s seventh largest airport was upgraded. For monitoring the more than 375,000 take-offs and landings a year, the construction of an 85 m high control tower was required.

Already during the tendering phase, it was specified that all of the partition walls of the difficult ground plan would have to be concreted together with the external circumferential walls.

Due to economic reasons, the PERI specialists planned a climbing system which involved crane-assisted climbing for the internal shafts and external formwork on crane-independent ACS climbing units. This allowed work to be carried out on the internal formwork even during extreme weather conditions as protection was provided by the external formwork.

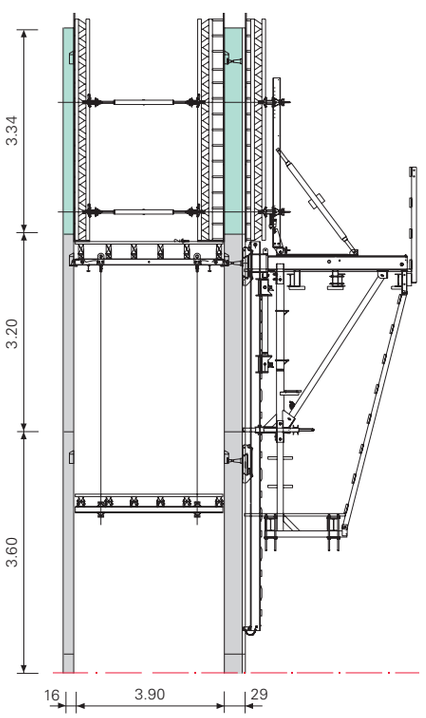
The standard 3.27 m high floors of the 24-storey building were constructed in four-day cycles.

The design submitted by the architectural practice of Göteborg-based Gerd Wingårdhs won the international competition to decide who would be awarded the contract. The 85 m high tower has become the new symbol of the Stockholm airport.



Irregular octagonal building layout: the radial arrangement of the brackets required a special platform frame in order to allow parallel positioning of the carriages.

The tower was insulated on the outside by inserting sheets of rigid expanded polystyrene into the formwork. Initially, the climbing anchors were recessed. When the last cycle had been concreted, the ACS R platforms were lowered step-by-step and were used as working scaffold for closing cavities and fixing the clinker brick cladding.



Crane-climbed internal platform

Self-climbing external platform

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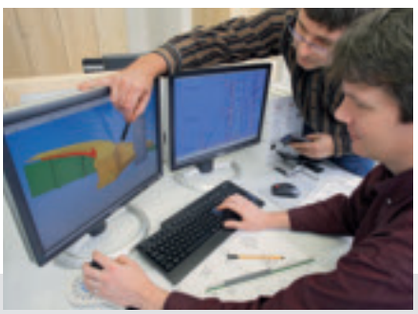

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