Self-Climbing Technology
Without exception, all current safety regulations must be observed in those countries where our products are used.

The photographs in this brochure show situations on various construction sites taken at a particular moment. Therefore, safety aspects or anchor details are not to be taken as a definitive guide to the way the equipment is to be used.

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

We reserve the right to make technical changes.

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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.

Over 300 spectacular, high structures have been climbed so far using the PERI technology. New projects are added on an almost daily basis.
PERI Self-Climbing Formwork
The experience of almost 40 years construction technology

Milestones of the PERI climbing technology

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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 The formwork was retracted on the scaffold, cleaned and then closed again.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.

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.

Patent specification issued by the German patent office in 1972.

Photo (right): the new Hong Kong Shanghai Bank Corporation building in London, 2,310 m² 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.
**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.

With the ACS technology, construction can continue in all weather conditions, allowing for efficient and safe working conditions.

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.
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.

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.

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.

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.
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.

**Five Variations of the Modular ACS System**

**A flexible construction for maximum building adjustment**

**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.
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.

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.
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.

**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

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

6th Step
- Close formwork, Concrete, Strike Clean Formwork

**Climbing Phase**
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.
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.

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

PERI Self-Climbing Formwork ACS P
Complete core formwork is climbed at the push of a button
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.](image)

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**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

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

6th Step
Close formwork
Concrete, Strike,

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**Climbing Phase**

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

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.

Double-sided gallows: ACS G scaffold unit climbing in a shaft.
PERI Self-Climbing Formwork ACS S
Inexpensive solution for shaft construction

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.

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

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

Project: Leura Apartment Building, Sydney, Australia.
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.

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.

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

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