Integrated secondary concrete lining solutions for tunnels
Putzmeister-Kern Strategic Alliance Developing State-of-the-art Secondary Concrete Lining Solutions

Leading engineering group Kern Tunneltechnik and specialist concrete pumps manufacturer Putzmeister have formed a strategic partnership for the development of concrete delivery solutions in tunnels.

Final tunnel lining with concrete formwork (cast-in-place concrete lining for large or complex tunnel sections) is currently a manual, labor-intensive process.

Together, the two leading companies are bringing the process into the 21st century with the development of new technologies that streamline the application of concrete secondary linings in tunnels.

Through this strategic partnership, two brands synonymous with quality and technological leadership are joining forces to provide advanced concrete application solutions for tunnels worldwide.

The state-of-the-art automated formwork filling system Putzmeister Formkret is designed to enhance safety, reduce workforce-related costs and project timelines, while allowing other work to be carried out onsite simultaneously.
Formkret: more than just the sum of its parts. Advanced technological solutions for tunneling.

Engineering group Kern designs hi-tech, bespoke automated concrete distribution formworks suitable for any type of tunnel with proprietary designs.

Putzmeister is a leading, record-breaking concrete pump manufacturer, with more than 50 years of expertise in the fields of concrete applications and pumping equipment.

The Automated Formwork Filling System combines Kern’s state-of-the-art formwork solutions for tunnels with Putzmeister’s leading technical expertise in concrete pumps, to optimize the concrete-pouring process in underground construction sites while delivering significant time and cost savings.

Clients are given a one-stop solution for all their concrete-related needs in tunneling: after carrying out an in-depth consultation regarding their site requirements, clients will be provided with a bespoke report outlining the technology solutions designed for their site, dealing with a sole provider of equipment and services.

This integrated solution for concrete delivery in tunneling is an integral part of our premium services, and highlights our commitment to engineering excellence.

With Formkret, the innovative automated formwork filling system, clients can improve site safety and significantly cut overall costs due to reduced workforce requirements and faster delivery times.
Formkret: Innovative 2-way valves filling system

The Automated Formwork Filling System is regulated by a set of 2-way valves integrated in the formwork structure, and connected by a single delivery line that links the entire system in sequential rows.

The concrete flow into the formwork is regulated by a diversion valve to ensure that the filling rate is synchronized on both sides. The diversion valve, regulated by the concrete pump, switches the concrete flow automatically between both “halves”. As the concrete reaches the optimal filling level in each row, the valves close, re-directing the concrete towards the delivery line, and allowing the formwork filling process to continue sequentially towards the next row. The operation of the 2-way valve is done automatically by radio remote-steered hydraulics.

Kern Bespoke Formwork, hi-tech solutions for tunneling

Kern’s Formwork system is a high-tech solution for cast-onsite secondary linings. The formwork is hydraulically operated by remote control, and can be aligned with the tunnel’s section without manual work.

The set-up and striking phases are regulated by an automatic locking system installed on the inclined struts and side wings. The same automation is also present on the stop-ends.

These innovations reduce workforce-related costs, helping limit the number of accidents typically associated with manual labor, and cutting down the project delivery timeline.

In terms of final quality, the formwork is coated with a nanotech ceramic layer to protect against abrasion and corrosion, which also helps to minimize cleaning times and reduces the need for protective oils.

Putzmeister BSA 1408 E Concrete Pump: 79m³/h

Once the formwork is fully set-up and secured in place, a Putzmeister BSA concrete pump is connected to the formwork: these pumps have an output capacity of up to 79 m³/h.

**Output** 79/53 m³/h*
**Delivery pressure** 71/106 bar*
**Engine / motor power** 110 kW
**Hopper** RS 909
**Capacity** approx. 600 l
**Filling height** approx. 1.3 m
**Remote control** wireless / 10 m cable

*Values for hydraulic fluid being fed to piston-side. All data maximum theoretical.
Automated formwork filling: Safety, Speed, Savings, Simultaneity

The automated concrete pour means the process requires less manual work, enhancing worksite safety and speeding up the overall process. In addition, the reduced overall footprint of the formwork structure means other equipment can work onsite simultaneously, optimizing the construction process.

Formkret can deliver significant work-force-related cost savings, while reducing the project timeline.

Upon completion of the formwork filling, the entire system can be cleaned in one go by pushing sponge balls through the delivery line with the aid of compressed air. The sponge balls, alongside any surplus material, are safely retrieved with a basket at the end of the delivery line.

Maintenance costs are also kept in check because of the use of pipes, which can withstand higher delivery pressures and have a longer service life than hoses.

Safety & environment
- Automation means reduced workforce onsite

Speed
- Faster overall tunnel construction
- Quicker hydrostatic filling process

Savings (time + costs)
- Reduced labor-related needs

Simultaneity
- Compact structure allows simultaneous work

Save 21 hours per block

Conventional system

Putzmeister + Kern System
Concrete pour procedure

- Once concrete reaches port 3, close pistons. Begin concrete pouring from point 4 until the pour is completed.
- Once concrete reaches port 2, close pistons. Begin concrete pouring from point 3.
- Once concrete reaches port 1, close pistons. Begin concrete pouring from point 2.
- Begin concrete pouring from point 1.

Formwork installation time is shortened, as the structure can be easily placed and aligns itself to the tunnel’s geometry. The integrated concrete delivery time eliminates need for manual hose switching, reducing worksite hazards and making it safer. The structure is then connected to the pump, which can be operated remotely.

Kern Formwork.
Automated Concrete Delivery

The Automated Formwork Filling System significantly reduces the overall number of operators needed onsite, while significantly increasing safety and helping deliver tunnel projects in a time-efficient manner.
Full concreting range for tunnelling

Concrete Logistics

Mortar injection for micro piles

Slab lining

Manual wet spraying

Cement bolts

Mechanized wet spraying

Formwork filling

Pumping Concrete curing

Sealing

Movement & check position

X0 12h

X6 7h

X4 2h

X4 6h

Remove sealing

X4 2h

82 hours

Total time

Pumping

X3 7h

61 hours

Conventional system

Putzmeister / Kern Solutions

KERN Tunneltechnik SA Product Range

POLYCENTRIC FORMWORK

BYPASS FORMWORK

TSK MODULAR FORMWORK

FULL ROUND FORMWORK

TRANSPORT ROOF

WALL MODULAR ELEMENTS

EXTERNAL FORMWORK

REINFORCEMENT GANTRY

ESCALATOR SHUTTER

INVERT FORMWORK

CURING GANTRY

TRUMPET FORMWORK

SLAB FORMWORK

SERVICE GANTRY

TRANSPORT SYSTEM
Automated formwork filling system

Traditional formwork filling systems require a sizeable workforce for the installation, assembly, maintenance, cleaning and operation of all the different components, placing more operators at risk of site-related accidents and stretching project delivery timelines.

Under this new cost-effective delivery system, Putzmeister’s concrete pumps and Kern’s formwork are integrated to offer a one-stop solution that reduces workforce requirements and installation times, while increasing the site’s overall safety.

One of the clearest advantages of the new system is the cost-savings it can deliver. Automation of the formwork filling can result in a reduction in overall workforce-related costs, while making the construction site significantly safer.