

Materials Services  
Infrastructure

# Flood protection

The right system for every job.



thyssenkrupp





Temporary flood protection  
by thyssenkrupp Infrastructure  
for Yuyao, China.

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# Global capabilities for infrastructure projects.

Whether it's mobility, urbanization, or climate or resource efficiency: As a leading supplier of civil, marine and foundation engineering solutions, we provide a full range of services for all your global infrastructure project needs. Our portfolio is organized into four divisions: steel sections (sheet piles, anchor equipment, flood protection), machinery, trench shoring and scaffolding systems.

We see ourselves as a full-service supplier to the construction industry. We support and advise our customers all the way, developing solutions precisely tailored to the job in hand. For this we can rely on the expert support of our own consulting engineers. We provide our customers with all the products they need to execute their projects.

Most of these products come from our own production, such as MÜLLER pile driving and extracting equipment and tk cold-formed sections. We are the exclusive distributors of tk anchor

equipment and Emunds + Staudinger | Krings trench shoring systems. We place great emphasis on sustainability. Our steel products meet the highest environmental performance standards: They are produced with minimum energy consumption, are eco-friendly in use, straightforward to dismantle and virtually 100% recyclable. Our driving and extracting equipment is quiet and low on CO<sub>2</sub> emissions. With offices throughout the world we are present wherever our customers need us. We know the local markets and their requirements and can provide tailored advice in the field, a key advantage especially in after-sales service.



## Flood protection made in Germany.

We have accreditation in all areas of our work. Our products are designed and manufactured exclusively at thyssenkrupp Infrastructure and its partner companies. We collaborate with leading hydraulic engineering and water management institutes to offer our customers state-of-the-art flood protection systems.



# Flood protection: Urgent need for action.

People have settled near rivers and coasts for thousands of years. Over the past few centuries river courses have been straightened and constricted, flood plains reclaimed and built on, and forests cut down. The consequences of these human interventions are climate change and an increasing number of environmental disasters. Floods, formerly once-in-a-century events, are occurring more and more frequently.

Experts are agreed that urgent action is needed: flood damage already tops the European loss statistics. Some of the losses are foreseeable and can be prevented by flood protection measures matched to local requirements. Flood protection and prevention are therefore among the most urgent tasks facing the local communities concerned.

#### End-to-end competence.

thyssenkrupp Infrastructure is a world-renowned supplier of flood protection equipment. We offer a broad spectrum of high-quality products and diverse technical services in hydraulic engineering and water management.

#### Our engineering services in detail.

- Structural analyses and stability tests
- Special proposals
- Preparation of draft
- Determination of dimensions and costs
- Design drawings and detailed solutions
- Advice and support for planning companies
- Documentation

#### Flood protection solutions.

Competent flood protection incorporates all safety and environmental requirements. We develop custom solutions taking into account local requirements and cost aspects. Each application has different priorities. Flood protection systems have to be versatile and meet many different demands. A basic distinction is made between permanent and temporary flood protection systems.



Residential areas in the center of Hitzacker an der Elbe have been hit by flooding on several occasions.



Sheet piling is used to stabilize a burst dike in Fischbeck.

# Temporary protection: Our tk stop log system.

In inner cities, port and industrial zones, and on road and rail crossings, permanently installed structures are often a hindrance. In these applications our tk stop log system can be used as a temporary measure instead of cost-intensive permanent solutions.

The system comprises just a few aluminum elements that can be installed at different heights. More elements can be fitted later to respond flexibly to changing conditions. For special applications we also offer tk glass logs which can be used in combination with our stop log system.

The tk stop log system is approved by the German Technical Inspection Association TÜV and has already proved successful as a temporary flood protection measure in numerous applications. It is a modular system and consisting of the following elements: tk stop logs, posts with or without back stays, clamping devices, anchor plates, and bottom seal.

The aluminum sections are currently available in widths of 50 mm, 100 mm, 150 mm. Specially developed seals made of EPDM material ensure the system remains watertight.

## Applications.

- Installation on existing ground and sheet piling structures
- Protective wall
- Dike opening
- Building protection



## Advantages at a glance.

- Simple design – no special tools required
- Robust construction, high reliability
- Low repair, maintenance and storage requirements
- Resistant EPDM seal
- Optimum storage systems
- Low manpower requirements
- Short, flexible response times
- No obstruction of traffic or views in normal conditions

### Foundation methods.

Various methods are available for mounting the tk stop log system:

With the anchor plate method, anchor plates are cast in concrete. The posts are connected to the support structure using threaded connections.

Steel sheet piling or concrete structures ensure reliable transfer of forces into the soil and offer secure protection against seepage and erosion.

The water loads on the tk stop logs are transferred to the foundation via posts.

With the sleeve foundation, a system protected by a patented thyssenkrupp Infrastructure design, the post is simply inserted into a sleeve and locked in place by turning a bar. A tensioning bolt ensures firm seating of the seals.



### Posts.

The posts can be made from various aluminum sections, galvanized steel or stainless steel. Their size depends on the expected loads. The post sections have been optimized to make them significantly stronger and lighter while using less material. If required additional backstays can be provided. Wall connection posts can be integrated into the brickwork or bolted on.

Finally, the tk stop logs are stacked into the installed posts. Using steplessly adjustable tensioning devices, they and the bottom seals are pretensioned and secured against upward movement.

An optional hood can be supplied to conceal access to the tensioning and locking devices.



**Post with sleeve.**  
The post is set into a concrete beam.  
All parts set in concrete are made of galvanized steel and stainless steel.  
Top: Sleeve foundation element.  
Bottom left: Center post with internal lock.  
Bottom right: Top view of sleeve.



**tk stop log system.**  
Top: Trial assembly of stop log system to protect Dresden's historic old town district.  
Bottom: Aluminum stop log system with backstays at Radeberger Spezialausschank bar, Dresden.

# Examples of our capabilities.



## Radeberger Spezialauschank bar on Brühl's Terrace in Dresden.

The bar occupies what was originally the bridge master's house, built on the bank of the Elbe in 1848. Guests come to this historic setting to enjoy hearty local food and beer. Not even flooding must be allowed to keep visitors away. Our demountable tk stop log system makes sure it never will. Altogether around 100 square meters of 200 x 100 tk stop logs are used. The maximum barrier height is 3.35 meters. Up to a water level of 2.40 meters, the structure is supported entirely by free-standing posts. If the water rises above this height, additional backstays are used.



## Dresden's historic center.

After the floods of August 2002, Dresden embarked on a major flood defense reinforcement program. As well as installing permanent barriers, the authorities also sought out efficient demountable solutions to protect the old town and the historic district. With so many attractions located here, the defense systems had to blend in sensitively and discreetly with their surroundings. The tk stop log system proved ideal. Mounted on a sandstone-clad reinforced concrete wall, it protects against flooding up to 9.24 meters. Passageways and outdoor stairways were also fitted with tk stop log systems. The result is guaranteed protection against even extreme water levels.

## Dresden-Gohlis flood protection system.

In the years 2002 and 2013, the Gohlis district of Dresden was completely flooded by the river Elbe. To permanently protect this part of town, we installed a complete flood protection system which at the same time provides access to the meadows along the Elbe. On sheet piling with a foundation of drilled piles, a massive concrete and stone wall was erected, fitted partly with demountable 200 x 100 tk stop logs. These have to withstand very high impact loads – up to 50 kilonewtons per 50 x 50 centimeters. In accordance with DIN 19712, double closures were provided for crossings and passages. The protective wall is around 880 meters long, with barrier heights of 2 meters and 0.60 meters. To store the demountable flood protection system, we designed special pallets that can be loaded and unloaded using a forklift truck, wheeled loader, or mobile crane.



# Examples of our capabilities.



## Raising the embankment at Moritzbach in Zwickau.

October 2015 marked the official handover of the flood defense system at Moritzbach in the Pölbitz district of Zwickau. Protective barriers were repaired and raised along a roughly 530 meter long stretch of water. And 300 x 50 tk stop logs can additionally be erected if there's an increased risk of flooding. The tk stop log system is 0.60 meters high, providing protection against flood levels that statistically occur once every 100 years. Special feature: The posts for the tk stop logs also serve as guardrail posts with hand and knee rails.

## Flood defense system, Kaditz flood relief channel.

The 2002 floods left the Dresden districts of Kaditz and Mickten under water. The damage was immense. To protect the communities against flooding in future, we designed a flood defense wall over 600 meters long. Around 490 meters of the wall consists of 250 x 150 tk stop logs. These are out of view when not in use and take up very little space. But as soon as the water level threatens to rise, the tk stop log system can be erected to create a stable barrier up to 1.70 meters high – tall enough to protect against water levels much higher than were seen in 2002. When river levels rise here, the Elbe can flow at a rate of up to seven meters per second. So we designed the system to withstand impact loads of up to 50 kilonewtons per square meter – at a height of 50 centimeters over the entire width. For storing the tk stop log system we supplied transportable roll-off containers specially fitted out to accommodate all the materials needed for one section, making the barrier quick and simple to assemble. And we were just in time: The barrier was put to the test almost as soon as it was completed – in the floods of June 2013.



## Double dike opening near Strehla.

Oppitzsch, a district in Strehla, a town with a 1000-year history, lies on a bend in the Elbe. In a major project here, a new earth embankment was built and the protective measures strengthened by means of demountable tk stop log elements. Twelve aluminum tk stop log elements were produced for a double dike opening with a clear opening of 3.60 meters and a water retention level of 1.24 meters. They are supported by posts cast into reinforced concrete piers. In the event of flooding, the flood defenses with a protective height of 0.80 meters are closed off with 14 separate stop log closures up to the intended flood protection height over a total length of 55 meters. All the demountable parts, accessories, and tools are stored on specially designed pallets in a roll-off container.

# Examples of our capabilities.

## Flood barriers for the community of Yuyao in China.

The 2016 to 2020 five-year plan of China's National People's Congress is committed among other things to improving citizens' quality of life. This also means improving flood protection measures. On this basis demountable flood barriers were installed on an approximately 4,700 meter long stretch of the Yuyao river in the Yuyao community. The very short delivery time made this a particular challenge. What's more, the customer was inexperienced and needed not only our technical expertise but also storage solutions and training for its staff. And local content requirements meant part of the production had to take place in China. We outsourced production of the roughly 5,000 stop logs and roughly 1,500 anchor plates to numerous Chinese and German suppliers. Shipments from Germany arrived not by sea but by rail. The entire delivery and production process was completed in around three months. Alongside the foundation work, we also implemented proposals for a storage model. In addition we provided training at local level: first for the construction firms charged with installing the system, and second for the team with the job of operating the barrier when a flood warning is issued.



## El Zagal floodwall, Fargo, North Dakota, USA.

The city of Fargo is situated on the Red River, which often flooded existing flood protection systems and roads in the winter months. Climate change and resultant changes to flood protection targets made it necessary to upgrade all dikes and secure the road crossings. The main challenge for us was that this was our first project ever in the USA. So before we could enter the market we first had to convince the United States Corps of Army Engineers (USCAE) of the advantages of our system. Next we needed a license from the Federal Emergency Management Agency (FEMA) and acceptance under the Buy American Act. The whole process took around nine months, after which we could start work on implementation. The road crossings are now protected by demountable barriers produced by us. In El Zagal a roughly 20 meter long, 1.5 meter high demountable barrier is operated in the event of flood alerts. The whole system was made in Germany and shipped in containers to Chicago, where it was handed over to our customer.



# Well thought-out: Our storage systems for demountable barriers.

Intelligent storage and logistics plans are essential for fast and reliable deployment of mobile flood protection equipment in an emergency. We offer the following storage systems:

### Roll-off containers.

Roll-off container vehicles are widely used in municipal services and the building sector. We offer this transport and logistics system for flood protection too. The containers' interior layout and fittings are based on the equipment to be stored as well as specific customer requirements. On request, we install shelving systems, lockable doors, interior lighting and further accessories.

### Mesh box pallets.

We supply mesh box pallets in various sizes. They can be stacked two or three high, have removable sidewalls and on request are separately lockable.

### Special storage systems.

For special requirements we offer further solutions such as semi-trailers, roll containers, standard sea containers, post pallets, and local storage systems.

### Our service advantage.

On request our specialists develop optimum storage and logistics solutions taking local conditions into account. Solutions take into account flood defense plans and locally available storage and transport facilities. With corresponding inspection, maintenance and training programs, we can create optimum conditions to ensure constant availability and rapid installation of mobile flood protection equipment.

### Spare parts service.

Our efficient service system guarantees fast spare parts supplies. On request we can keep a defined range of spare parts available for you.



### Advantages at a glance.

- Appropriate sorting and well-organized storage systems
- Low-cost storage with optimum weather protection
- Efficient and flexible loading and handling technologies



Advantages at a glance.

- Architecturally attractive flood protection, especially in built-up areas
- Does not obstruct the view
- High resistance to corrosion and weathering

# Functional aesthetics: Our tk glass wall system.

Our fracture-resistant tk glass wall systems made from multi-pane safety glass provide a particularly stylish flood protection solution. They are designed for permanent use and mounted on masonry, concrete beams, or sheet pile walls. They provide ideal flood protection without obstructing visibility, e.g. for attractive urban areas.



The tk glass wall system blends in harmoniously with the landscape and does not obstruct the view.

### Applications.

- As an alternative to obtrusive masonry when more daylight is required
- Tourist areas, e.g., along terraces, viewing platforms, etc.
- Areas inaccessible for erecting demountable systems
- Locations with a very short warning time that does not allow the erection of a demountable system
- Public areas with high architectural and urban planning demands

The glass elements are made of multi-pane safety glass in line with structural requirements. Additional panes of glass can be added on the land or water side to protect the load-bearing panes of toughened or heat-strengthened glass. The additional panes are non-structural, which means that the safety of the barrier is still guaranteed even if they are damaged.

The dimensions of the panes can be varied and are chosen to suit structural and aesthetic requirements. The perimeter frame is fabricated from stainless steel or aluminum sections with an internal EPDM seal. The safety glass in its frame is fitted between the welded aluminum or stainless steel posts with the help of EPDM gaskets so that no stresses can build up, which might damage the glass. Verified structural analyses form part of the system documentation. The visual effect of a glass wall can be further enhanced by colored metalwork.

# Examples of our capabilities.



**Glass wall in the Turmschanzenstrasse area, Magdeburg.**

The major flood protection upgrade program in Magdeburg also included the areas to the east of the Elbe. To maintain the view of the river in the Turmschanzenstrasse area, we installed glass walls at various points consisting of individual glass panels in different sizes. Special feature: The thickness of each glass panel was matched to the different impact loads. On the river-facing side exposed to very high loads, glass thicknesses of up to 76 millimeters were used; on the side facing away from the river the panes are significantly thinner. This made the overall solution extremely cost-efficient. A further highlight of the project is our manually operated fold-up aluminum panel providing access to the river bank. Measuring 3.00 x 0.80 meters, it is made of checker plate to give vehicles driving over it increased grip. It also operates on a completely mechanical basis – no electricity or machinery is required – and can be mounted and dismantled by two people.



**Glass wall in Neufelderkoog on the North Sea.**

Flood protection measures often restrict the view of the sea. But not in Neufelderkoog on the North Sea coast. Here a flood defense wall has been replaced at numerous points by barriers made of glass elements to maintain an open view. The base consists of a brick-faced reinforced concrete wall mounted on sheet piles. This forms a stable anchorage for the steel frames that hold the 68 mm thick panes of laminated safety glass. Each individual pane of glass measures 100 x 120 cm and weighs about 160 kg. The transparent panes offer the best possible protection against storm surges. In addition, they screen off wind and noise and also provide a safety barrier.

**Glass reinforcement for river dike in Brake.**

The 2nd Oldenburgischer Deichverband, a public body responsible for building and maintaining dikes, planned to strengthen the Weser Dike near Brake and raise the flood defenses by half a meter. For the promenade, the planners decided on a flood barrier featuring a brick-faced reinforced concrete wall, glass and stainless steel frames – to the benefit of the town and the neighboring hotel. Local residents and visitors can still enjoy the view and the

atmosphere of the majestic river Weser. The use of stainless steel for the frames and posts meant that the glass panels could be as large as possible and the support structure as slender as possible. The surface of the support structure is brushed, extremely scratch-resistant and requires no additional coating. A key advantage of the permanent glass wall system: It is always ready for use.



# Permanent safety: Our steel sheet piling in dike construction.

Our proven steel sheet piling is the classic solution for flood protection. A flexible and highly cost-effective solution, it has been used for decades all around the world. Mostly used for permanent systems, steel sheet piling can also serve as a base for temporary systems. This opens up a wide range of possibilities for the design of optimum flood defense solutions.

## Sheet piling in dikes.

In a flood, dikes are subjected to enormous loads. Often they are no longer capable of meeting these loads as the increasing regularity of flood disasters was not foreseen by their builders. Here, our steel sheet piling offers an efficient and cost-effective solution because it can be installed quickly and easily in both existing and new dikes to stabilize and seal the dike and increase its load-bearing capacity.

Sheet piling is flexible and can follow the movements of the dike, ensuring long-term stability and water-tightness. If necessary, the sheet pile interlocks can be sealed. Various bituminous materials are available for this. These sealants can be installed in the interlocks either at the factory or on-site. One particularly reliable solution is the patented tk interlock sealing system made from a polymer. This seal is fitted into the interlocks at the factory and is suitable for all methods of sheet pile installation.

If the piling is used for a visible wall, the polymer seal is particularly recommended as it is heat-resistant and does not run out of the interlocks in the heat of the sun. Naturally, all recommended sealing systems are groundwater-neutral and ecologically safe. Ecological reasons also clearly favor the use of sheet pile walls. As 100% steel products they are particularly environment-friendly as they can be removed without residues and reused.

## Sheet piling applications:

- New dike construction and dike repairs
- Dike raising
- Base for further flood defense structures such as tk glass wall system or demountable flood barriers

## Lightweight steel sections.

As well as hot-rolled sheet piling, cold-rolled piling sections are used for flood protection. They are cold-formed from flat material into sheet piling profiles and are mainly used for sealing purposes. They are a long-proven low-cost solution. In general they are used in the same way as hot-rolled sheet piling sections, taking their load-bearing properties into account. Production is cost-effective and service properties are ideal for many flood protection applications. The visible parts of the pile wall can be architecturally enhanced in various ways, including painting, brick facing, facing elements, greening, etc. Sheet piling in dikes is a prerequisite for mobile dike-top systems used to temporarily raise the height of dikes when there is a risk of flooding. It also forms an ideal base for raising the flood protection level of glass systems and protective walls.

## Sheet pile wall modules.

When existing dikes or flood defense systems are not high enough for extreme flood situations, steel sheet pile wall modules can be used as permanent or temporary flood defense solutions. They can be used cost-efficiently as dike raising elements and dike openings to protect residential and working areas in densely populated zones.

## Applications of sheet pile wall modules:

- Protection of residential and working areas
- Densely populated zones
- Dike raising elements
- Dike openings



## Advantages at a glance.

- Absorb all static and dynamic forces generated by the flood
- Stability of the dike is guaranteed even if most of the water-side section of the dike is already eroded
- Prevents dike seepage and erosion
- Different groundwater levels on either side of the dike can be offset by staggered driving or slitting of the sheet piles
- Sheet pile walls are so flexible that they follow the movements of the ground without being damaged
- Structures such as dike openings, sluices, pumping stations and locks can be integrated seamlessly using sheet piling solutions
- Sheet piling can project above the top of the dike and thus raise the flood protection line of the existing dike

# Examples of our capabilities.

## Raising the Elbe dike in Bleckede–Alt Garge.

Due to changes in flood protection regulations the flood defenses in Alt Garge – a district of Bleckede – had to be significantly raised. Our sheet pile walls are used where residents have no direct view of the river. They consist of Larssen 716 sections in lengths of 7.60 and 11.70 meters and Larssen 628 sections with a length of 11.00 meters. The piles were deliberately left uncoated – the reddish tone created by corrosion blends harmoniously into the landscape.



## Steel sheet pile walls in Mönkebude on the Oder Lagoon.

To save space the flood protection line in the bathing resort of Mönkebude was constructed as a 400 meter long sheet pile wall. Made of 5.5 to 8 meter long Larssen sections the wall projects between 1.50 meters and 2.20 meters out of the ground and has a quadruple coating of UV-resistant coating materials. The color coat extends 0.80 meters below ground level. The green top coat matches the shrubs planted in front of the wall. A patented polymer seal reliably prevents leaks. Openings for cars and pedestrians allow access to the beach, campsite and docks. When floods threaten, these openings are closed with a double row of tk stop logs.



## Dike raising in Gallin on the Elbe.

As part of a comprehensive modernization project to strengthen flood defenses in the town of Gallin we supplied lightweight sections to raise the dike. When floods occur a mobile tk stop log system is placed on the dike sections, which have reinforced concrete capping beams. This provides an additional 1 meter of protection over a length of 80 meters. Compared with conventional dike raising, this temporary solution is much cheaper and is quick and easy to install when floods threaten. As an additional measure we created a dike opening in Iserbegka, consisting of concrete-faced sheet pile sides, a sheet pile sealing wall and a reinforced concrete ground beam.



## For specific requirements: Our custom solutions.

Flooding causes enormous property damage inside buildings too. A reliable protection system that takes into account the specific requirements of the building is an important preventive measure in all flood-endangered areas.

We offer proven flood protection doors and gates in various styles for watertight closure of openings in buildings and flood protection systems:

- one and two-leaf doors
- sliding doors
- tilting, swivel and miter gates
- tk stop log and stop panel systems for window and door openings

The materials used are steel or aluminum with various corrosion protection and design possibilities.

**Stop panel system.**  
Focus on locks and weirs.

The stop panel system is a special version of the tk aluminum stop log system. Stop panels are fabricated from stop logs and inserted into the support structure as a complete wall panel and then braced for sealing. They are also suitable as inspection closures for locks, weirs and inlets.

Stop panels can also take the form of large-area walls of aluminum or steel and brought from their storage position into their protection position with the lifting gear provided. This allows the panels to be assembled quickly and with little effort.

Smaller stop panel systems are available in various designs for doors, windows and gateways. These panels are made to measure for the specific opening.



**Building protection safeguards assets.**

The door leaves are welded structures with plate thickness and stiffeners designed to match the water pressure. High-quality, extremely weather resistant EPDM rubber is used for the seals. The fastening, sealing and closing systems are proven assemblies from shipbuilding. Here we utilize our long experience in many areas of maritime structures and construction techniques.

In addition to manual operation, electric or hydraulic operators can also be supplied. Door type, design and outer appearance are selected on a project to project basis, allowing us to exactly meet our clients' exact needs and wishes.



**Pipe needles.**

To control water levels and seal off waterways, we supply pipe needles and needle weirs made of steel and aluminum.



**Fold-up flood protection system.**

Our fold-up TKR flood protection system can be designed as a floor panel suitable for pedestrian and vehicle use, or for other purposes. Without obstructing the view of the sea, it can be converted quickly into a highly efficient barrier against water and debris.

We develop custom solutions in line with local requirements in cooperation with our customers.

Applications:

- Custom solutions
- Temporary increase in flood protection level
- Construction of new sheet piling solutions

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