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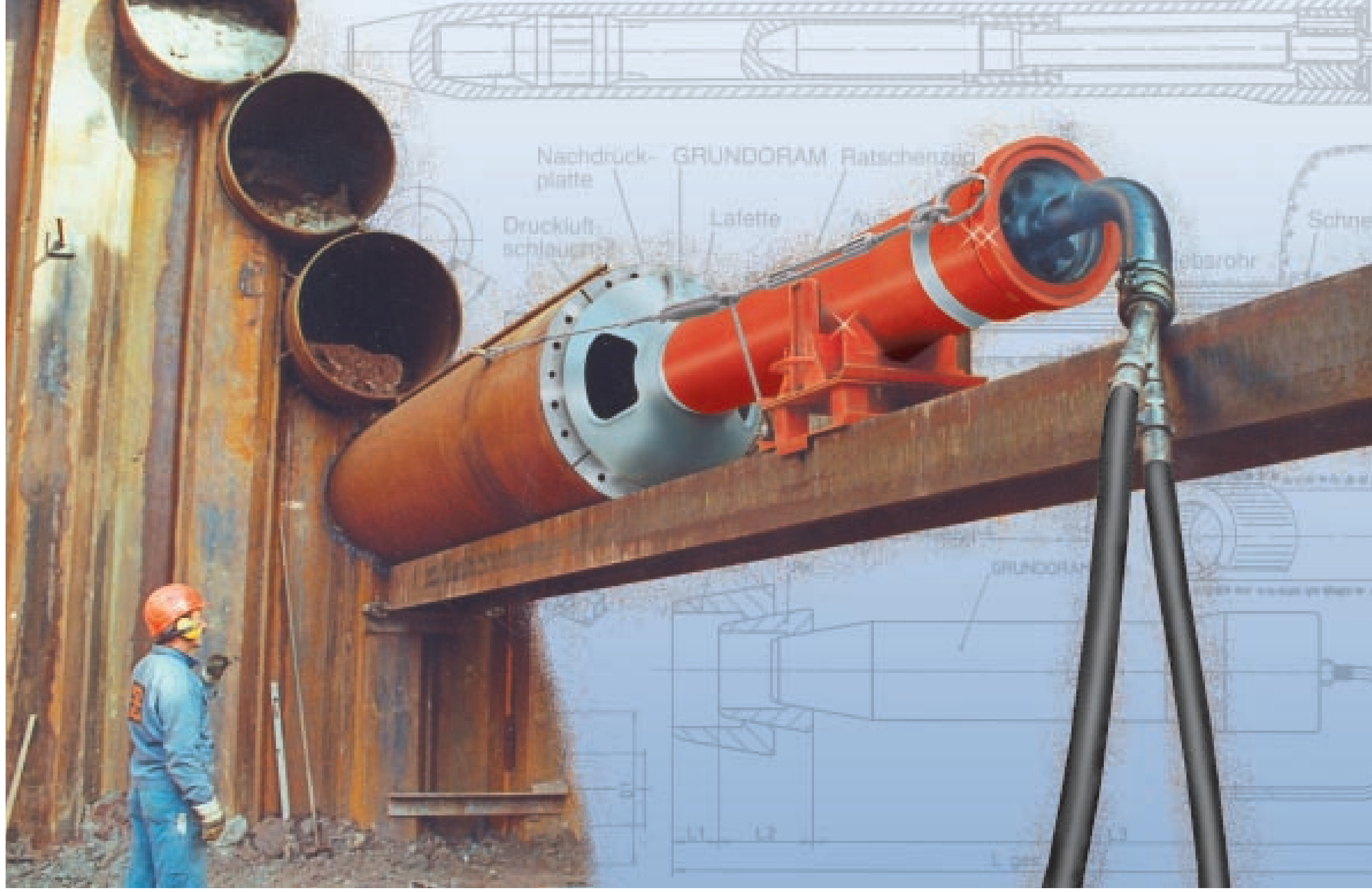

Superior ramming technique for extreme projects

GRUNDORAM special edition incuding lots of jobsite examples.

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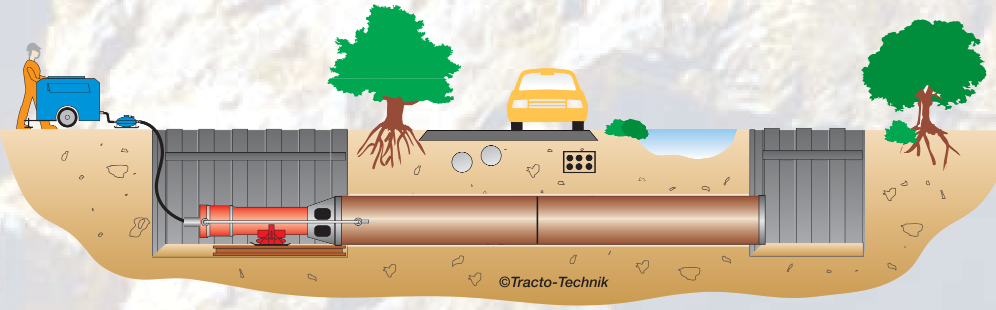
GRUNDORAM

A ramming machine for almost any soil quality

Methods

Ramming and more



Pneumatic ramming machines are used for the dynamic propulsion of the ramming method.

With the ramming machines from TRACTO-TECHNIK, you can lay open steel pipes, either as protection or product pipes, with diameters up to 2.000 mm for lengths of up to 80 m in the soil classifications 1 - 5 (partially even in classification 6 - easily removable rock) beneath railway tracks, highways and rivers. Pipe propulsion can also be used in **vertical** direction, e.g. when laying foundations. With special adapters, the ramming machines from TRACTO-TECHNIK can also be used for **ramming sheet piles** (also regard the following examples for application). As a third possibility it can be used for the **renewal** of damaged **pipe lines**.

Altogether, there are 12 machine types with up to 20.000 kN thrust force available. The induced impact energy is transferred to the whole pipe string in the best way possible. The propulsion often reaches approx. 15 m/h.

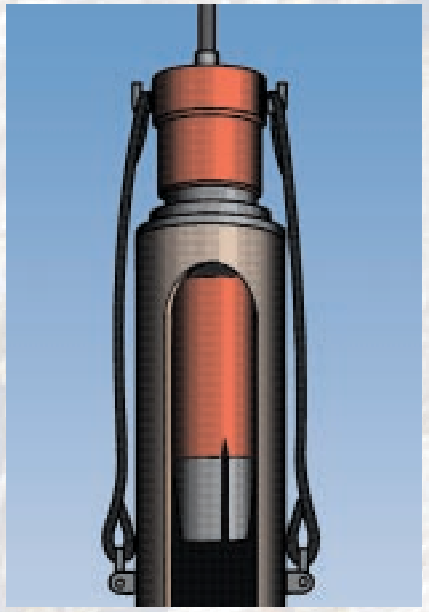
The tight fitting connection between pipe and machine is achieved with conical plug-on tapers and/or multipart impact segments. The special soil removal adapters/tapers have two holes for releasing part of the soil carried along, thus causing relief.

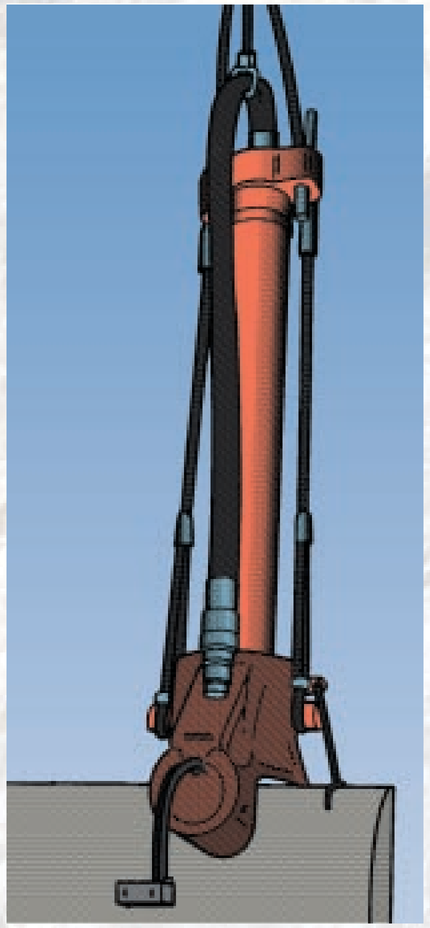
The operation-technical and economical advantages, in comparison with other propulsion methods, result from the fact, that

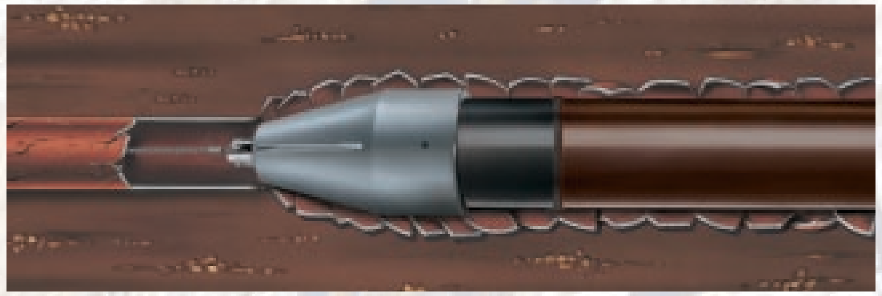
- abutments (in the rear, front or underneath) are not required, thus shortening the set-up time,
- the working pits need comparably small working widths and depths (little cover required),
- instead of loosening the soil structure in the propulsion path, it is packed smoothly to enclose the thrust pipe securely and protectively; this also makes pipe propulsion in water-bearing and rocky soils possible.

Due to its very small displacement volume in the area around the cutting shoe, heave of the ground or street surface can be ruled out even with little cover.

After the ramming works have been concluded, the soil has to be removed with the help of water pressure in combination with air pressure, or water pressure alone – with sufficient safety measures, soil removal up to DN 500 is also allowed with air pressure alone.

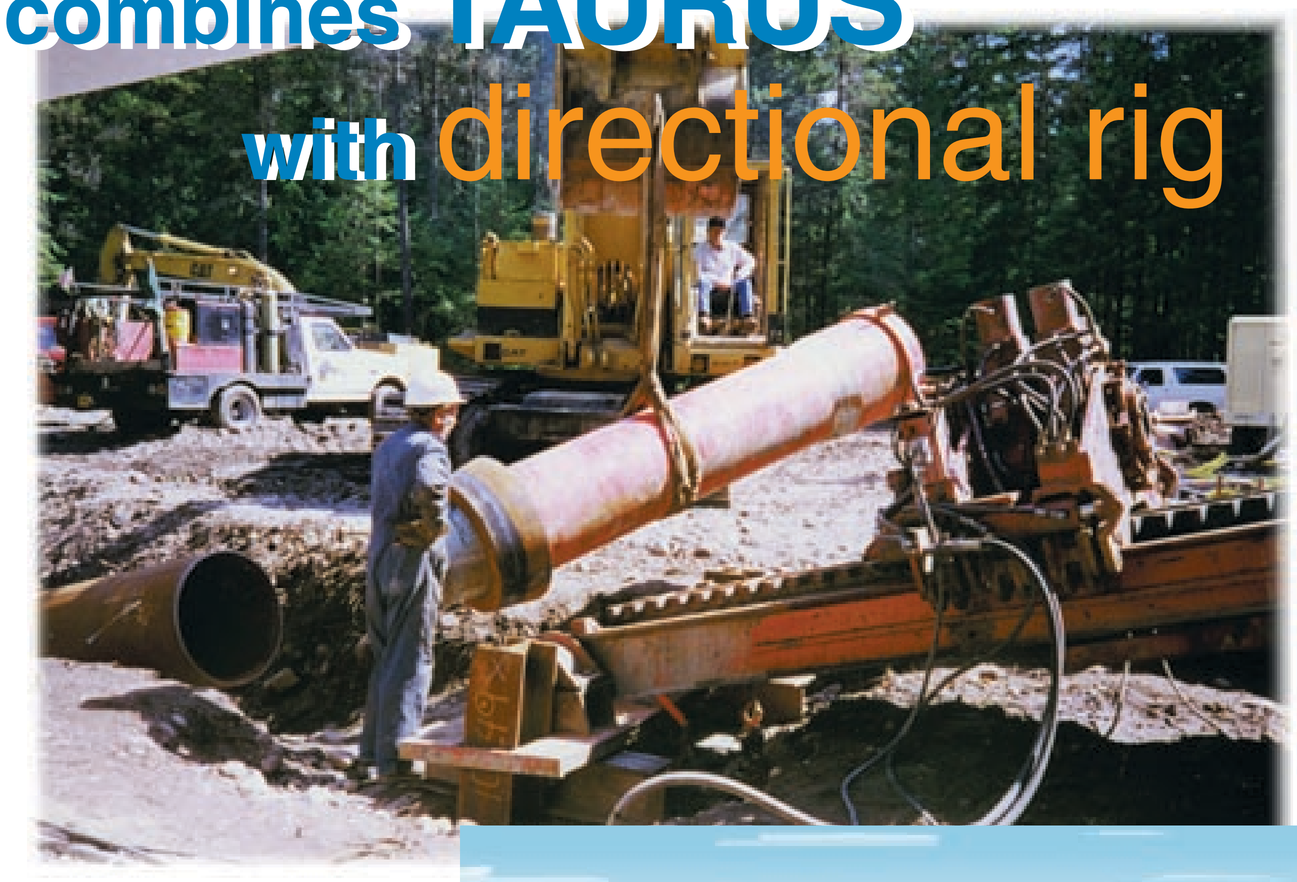






Special application

Contractor Kamloops combines TAURUS with directional rig



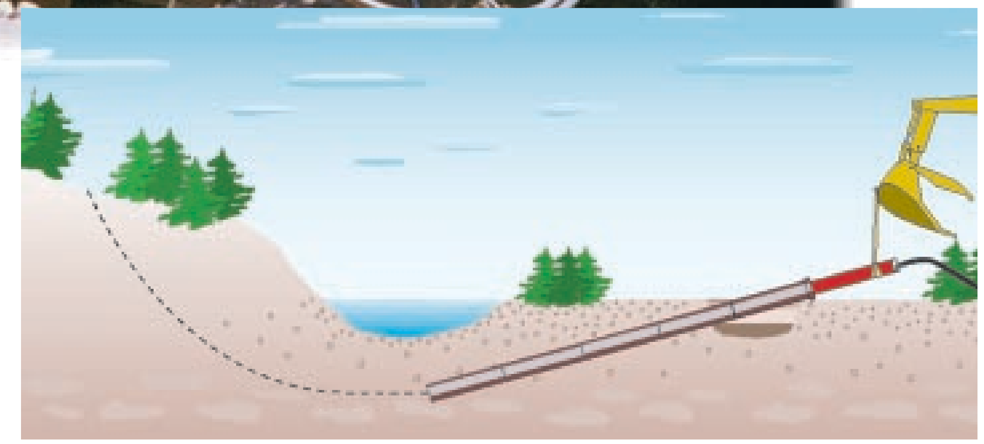
Crews prepare to install a section of Conductor Barrel with GRUNDORAM TAURUS.

Montainous Oil Pipe Installation made possible

35 miles away from infamous Mt. St. Helens, beneath the Toutle River near Castle Rock, WA, a damaged crude oil line threatened to burst. Although the line had been installed at a safe depth, years of volcanic run-off (including large rock) had exposed the pipe. Damage and corrosion was now a fact, and oil line officials wanted to remedy the situation before the line could spill.

Kamloops Retained

The contracting bid was awarded to Kamloops Augering, Ltd. The chosen boring tool was an American Augers directional drilling rig. Because of the complexity of the bore, combined with a tight time frame, Kamloops staff incorporated other trenchless methods to make the bore more efficient. Kamloops had a unique way of using pipe ramming tools to assist directional drilling rigs in difficult bores. The process was to ram a pipe in at an angle, instead of horizontally, dubbed a



The Conductor Barrel was installed at a 15° angle, providing a „clean hole“ for directional drilling. The bore exited 400 ft higher than the starting point.

Conductor Barrel, is then cleaned out with an auger, leaving a “clean hole“ for the directional drilling rig.

The directional drilling rig can then advance the drill bit through the Conductor Barrel to the bed rock without any steering problems or complications caused by loose gravel and large rocks. This clean hole also allows the bore to start on-target and provides a friction free last leg for product pull-back.

On-Site

The 670 m (2200 ft) bore would start 152 m (500 ft) from the river bank, travel about 21 m (70 ft) beneath the river and continually arc up until exiting on the side of a mountain. The bore was to follow a 1400 m radius.

The pipeline owner specified that all Conductor Barrel pipe be removed to avoid complications with the new oil line. For ease of of retrieval two diameters of pipe would now be used, creating a barrel within a barrel. Installed inside and beyond the 200 ft of Ø 762 mm (30“) pipe was 500 ft of Ø 610 mm (24“) Conductor Barrel. This meant that only 92 m (300 ft) of the Ø 610 mm (24“) barrel would be surrounded by soil, making it easier to remove.

Ramming Begins

Kamloops used a GRUNDORAM TAURUS pipe rammer (largest available rammer) to perform the pipe installation. The first 12 m (40 ft) section of Conductor Barrel was quickly rammed in. The second section was then welded to the first.

To suspend the TAURUS as it rammed the pipe a Caterpillar 325 back hoe was used. Just two hours in the ram, crews were already preparing the third section of pipe for installation. An auger was used to remove spoils within the pipe. Crews repeated this process until reaching bedrock, 21 M (70 ft) below the river, a few days later.

Drilling & Reaming

With the Conductor Barrel installed Kamloops crew put their steerable boring system on line while truetracker magnetic wires were laid to help guide the bore. The tricone mud motor was attached to a non-magnetic drill stem and the big directional rig was put to work.

Stem after stem was added as the line made its way down the Conductor Barrel. Once bedrock was reached, the initial bore was underway. The 178 mm (7“) drill stem travelled flawlessly beneath the Toutle River and under and out of the side of the mountain. Crews then attached a Ø 432 mm (17“) reamer to open the hole, followed by a Ø 508 mm (20“) reamer. The drill stem was then resent to pull back the waiting 356 mm (14“) crude oil product line.

Pipe Retrieval

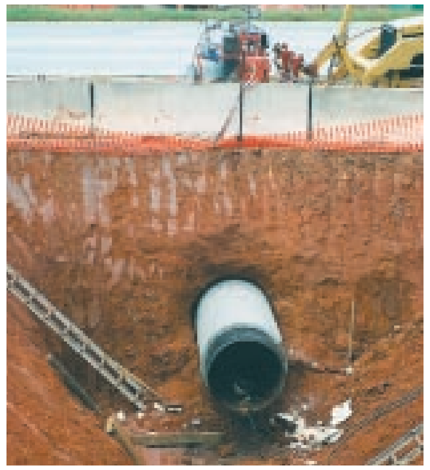
To recover the Ø 610 mm (24“) and Ø 762 mm (30“) Conductor Barrels the rammer was positioned inside a special adapter which was connected to the final section of the Ø 610 mm (24“) Conductor barrel. As the trenchless tools pulled each section of Ø 610 mm pipe from the rocky ground, they were methodically cut and removed. The same had been done with the Ø 762 mm (30“) Conductor barrel.

Conclusion

In the short span of several weeks Kamloops worked through the problems the difficult terrain offered by combining trenchless technologies.

Horizontal pipe ramming

Keep that traffic moving



Assignment: Install concrete-coated section of new gas pipeline under busy Alabama state highway.

The versatility of trenchless pipe ramming equipment for replacing pipelines under major highways without interrupting traffic was recently demonstrated in a project undertaken by Colonial Pipeline of Atlanta, Georgia (USA).

The project involved replacing a 36” (900 mm) gasoline product line 6 km north of Talladega, Alabama on Highway 77, a heavily travelled highway east of Birmingham. When the pipeline was originally installed, the product pipe was allowed to be placed inside a steel liner. This resulted in cathodic corrosion occurring between the two steel pipes. Since Highway 77 is due to be upgraded to a four lane highway in 1993, the decision was made to replace the pipeline this summer. No steel liner would be used to surround the new product pipe. To protect the pipe, specifications called for a 50 mm thick concrete coating on the section of product pipe that would lie under highway 77. The old portion of pipe would be capped and abandoned.

New Methods Sought

These special requirements and recent bad experience with auger boring led the contractor E&M Construction to use TRACTO-TECHNIK (T.T. Group’s) pipe pushing equipment which is normally used for driving steel casings. As the percussive impact of a GRUNDORAM model GOLIATH would normally break the concrete coating of the steel pipe, a different method of ramming had to be used. A 42” (1.050 mm) steel pipe was first driven underneath the highway over a length of 40 m at a speed of 8 m/h. During the pipe ram, a water/Bentonite slurry was continuously pumped to the front of the steel pipe via a small 1” (25.4 mm) steel tubing welded onto the main 42” pipe. The Bentinote not only facilitated the forward mouvement of the steel pipe but also stabilised the bore and created a greasing layer around the pipe.

After the completion of the bore, an excavator was used to pull the 42” casing back into the pit. Thanks to a 30 ton mobile truck, the concrete-coated pipe was lifted and positioned during the pull back. After each 6 m section of concrete-coated pipe was pulled in place, the next section was then welded to the pipe string.

Within two days the project was wrapped up without interruption to highway 77 traffic.

Retailer report

The biggest GRUNDORAM jobsite in Brazil ever

by Jorge Dequech of Sondeq Ltda., São Paolo

In 1998 a 25 years old project started concerning a gas pipeline connecting Brazil and Bolivia. Linking the production area in Bolivia to southeast Brazil, the crowdiest and biggest industrial area in the country,

Pulling of the covered gas pipe into the steel pipe.

the pipeline has to cross mountains in Bolivia, a huge swamp land inside Brazilian territory until reaching the farmyards of São Paulo State on the first section of this project.

Part of this contract was delivered to Techint, responsible for the section inside São Paulo State between the cities of Paulinia and Castilho in a total of about 520 km of pipes. The had exactly 33 crossings to be done, so Techint started using their boring machines on the jobsite but, after the 3rd crossing they were challenged by Novatec do Brasil, a company specialized in pipe ramming trenchless technology, to test their ramming machines.

The Novatec staff came to the jobsite on August 26th challenged to install more than 1.100 m of Ø 1.016 mm (40") casing steel pipes on 30 crossings from 24 to 72 m length before the deadline of December 25th. To achieve this they used their two GRUNDORAM KOLOSS machines, supplied by Sondeq Comercial Ltda., TT's longtime distributor in Brazil. The two crews of five peolple each were under responsibility of the engineer and company partner Mr. Fábio Livio de Moraes who has a 5 years background on rammers.

At the end of the project 8 m of pipe Ø 1.016 mm had been rammed and cleaned a day per equipment. The pipes were cleaned with compressed air or excavated manually. After cleaning the Ø 812 mm (32") gas pipelines, pipes with a concrete cover of 50 mm were in-

View of the steel pipe after soil removal.

GRUNDORAM KOLOSS ramming the steel pipe ND 1000 over a length of 72 m under a highway.

stalled inside the casing by the Techint's crew.
With this jobsite Novatec had maybe done the biggest crossing ever made with a GRUNDORAM in Brazil: a Ø 1.016 mm crossing of 72 m length under a highway. The complete installation took 6 days with one crew ramming 12 meters of pipe during the day and another crew cleaning the pipe section during the night.

Hotizontal pipe ramming

GRUNDORAM type KOLOSS installs a 600mm steel pipe beneath the river Erft

◀ View over the river Erft and the starting pit.

Thanks to a GRUNDORAM steel pipe pushing hammer type KOLOSS made by TRACTO-TECHNIK GmbH a 600 mm steel pipe was installed near Neuss in Germany.

A pipeline to carry oxygen and nitrogen for MESSER GRIESHEIM from Dormagen to Uerdingen required a number of road and river crossings. Contractor Haakshorst from Dortmund was awarded the contract.

Part of the project required a river crossing underneath the river Erft as well as under a side-river at a depth of just 2 m. After thorough considerations and comparisons of different pipe installation methods, contractor Haakshorst opted for the use of the dynamic steel pipe installation system GRUNDORAM made by TRACTO-TECHNIK. Part of the pipeline installation project required a steel pipe DN 600 to be installed underneath the river Erft and 200 m further down the river beneath a side-river at a depth of 2 m beneath the river bed. In view of previous experiences with GRUNDORAM equipment, contractor Haakshorst decided on using a Koloss pipe rammer.

Over a distance of 50 m two steel pipes of DN 600 had to be installed parallel. Each steel pipe section was 9 m in length and butt-welding the steel pipes together made for a total length of 50 m. The steel pipe was scheduled to be a protection pipe for a DN 400 oxygen and/or nitrogen.

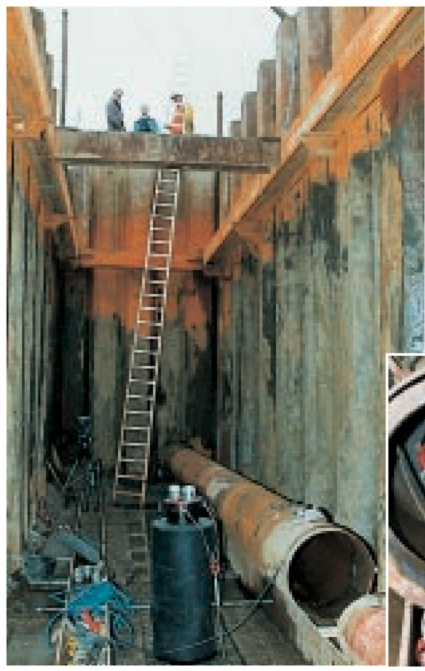
To transmit the full impact force of the rammer onto the steel pipe, conical ram cones were placed between hammer and steel pipe. In order to guarantee the operator safety during operation, a starting and exit pit of L = 15 m - H = 6 m - W = 4 m were made using steel sheet piles. Further preparations included a set of I-beams onto which the GRUNDORAM hammer and steel pipe could slide forward thanks to the TRACTO-TECHNIK cradle with air-cushion.

Ground water flooding into the pit turned out to be the main problem on the job-site. To pump the water off the ground in front of the starting pit, 6 dewatering wells with a capacity of around 300 m³/hour were dug.

Despite these preparations the inflooding water was still so strong that smooth operation as usually experienced during a GRUNDORAM jobsite could not take place. An additional seal-off cushion (operated by compressed air) was further located inside the steel pipe to seal it off at the front and prevent further water from entering into the starting pit. Once a 9 m section of steel pipe had been pushed forward, this seal-off cushion was carefully removed, replaced in the next pipe section and pumped up again.

Normally such sealing off is not required when using steel pipe ramming beneath rivers as the core of soil inside the steel pipe usually does not allow any water to flood into the pit.

However, if there is a serious risk of such water inflooding, the use of a seal-off air cushion of the right dimension can be an optimum solution.



The pneumatic steel pipe rammer KOLOSS driving the steel pipe.

◀ The dimension of the starting pit with a seal-off cushion located inside the steel pipe.

Patents

Soil removing Cones

TRACTO-TECHNIK proudly announces that the patend DBP 3426374 has now been confirmed by the highest German court the Bundesgerichtshof.

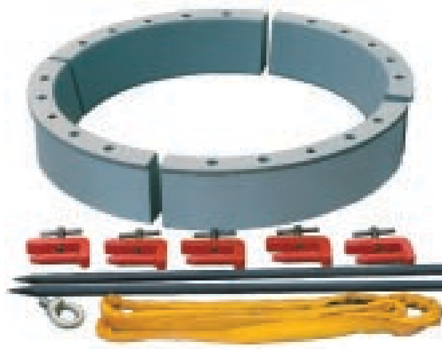
In steel pipe ramming the use of patented SOIL REMOVING CONES have proven to be a valuable accessory to allow soil evacuation during a steel pipe driving process. These cones allow partial soil evacuation via a window on each side of the cone.

The use of these cones is of vital importance for the success of the operation as the soil is evacuated during the pipe ramming so that the pneumatic impact of the hammer is better transmitted onto the first steel pipe.

In many soils the subsequent evacuation of the remaining soil would not be possible without such a cone. Once the entire pipe ramming process is completed, the remaining spoils are evacuated entirely by using a pressure plate connected to the air compressor. In the majority of the cases the air pressure building up inside the steel pipe suffices for blowing the spoils out. In tough soils or for larger diameter rams, it may be necessary to evacuate the spoils via a high-pressure water jetting system.

Patents

Cotter segments for pipes up to 1.400 mm (56”) Ø



Cotter segments have proven their effective use on numerous steel pipe laying installations worldwide. Their main advantages (when used in conjunction with conical ram cones) are:

- they do not flare the steel pipe ends thus enabling the immediate butt welding of the subsequent ramming pipe - this overcomes the costly and time consuming requirement to cut the flared pipe ends square.
- the cotter segments are made up of several parts which reduce the weight making it easier and safer during assembly of the cotter segments.

Cotter segments are available for all (European) standard steel pipes (see the following table). Each ram cone set is made up of 4 cotter segments. Smaller diameter segments are manually placed inside the steel pipe. Larger diameter segments (for pipe diameter in excess of 700 mm) requires lifting equipment such as an excavator or fork-lift. Assembly holders (red) position the segments centrally in place until a suitable ram cone (RK) or soil removal cone (REK) is then fitted.

When Gene Miller says it was a tough job, you better believe it. The man known by all as Miller the Driller is celebrating 50 years in the business. How does a pioneer in the trenchless industry celebrate 50 years? He tackles the biggest pipe ramming job of his career.

Miller the Driller

Giant pipe ram in Montana/USA with TAURUS

The pipe ram took place underneath a section of I-90 about 8 miles west of Bozeman for JTL Group, Inc. JTL is a highway contractor with a gravel pit on the north side of I-90. They are opening another pit on the south side. The bore under the interstate will facilitate a conveyor system between the two pits so wash and grading facilities can be shared. A large bore was needed. The 66 inch Ø pipe for this job makes it one of the biggest ø pipe rams to take place in North America in some of the toughest conditions anywhere.

According to Miller, an initial attempt to bore the 160 foot run with a conventional auger jack and bore failed. He couldn't make any headway because of the gravel, rocks and boulders present in the soil. Miller turned to pipe ramming, a method he pioneered in his country. Miller already had a Koloss GRUNDODRAM from TT Technologies in his pipe ramming arsenal, but knew that this job needed more. He was aware of a pipe ramming monster and knew where to find it. Miller contacted TT Technologies Product Specialist Mike Schwager and the crew was off to Aurora, Illinois to pick up the world's biggest pipe ramming tool, a 24 inch Ø, 10.580 pound, Taurus Grundoram. Over the years, Miller's jobs have become bigger and bigger. His equipment needs have increased as well. The job in Montana required 3 semi-trucks and a pickup.

Once the Miller crew returned to the Montana site, they began preparing the pipe and Taurus Grundoram for the big job ahead. Arntzen Corporation (Rockford, IL.) supplied the 66 inch Ø steel pipe sections for the ram. They were 3/4 inch thick and 20 feet long. Arntzen also fabricated a rolled cone reducing adapter to go from a 66 inch ø to a 60 inch Ø. Turn buckles were used to hold the reducing adapter in place. This saved a tremendous amount of time because it eliminated the need to weld the adapter to each pipe section.

A 60 inch segmented ram cone brought the Ø down to 48 inches. A 48 inch ram cone was then used to reduce the Ø to 30 inches. A 30 inch soil removal adapter was the last piece. It reduced the diameter again and connected to the Grundoram. This configuration is key to a successful pipe ram. It ensures a tight fit between the tool and the pipe, allows spoil to be ejected during the ram and helps minimize pipe flaring.

A cutting shoe was fabricated on site. The ram went very well, with ram times ranging from 30 to 75 minutes per 20 foot section. Welds took 6 to 7 hours. While ground conditions did not stop the progress of the ramming tool, it did make spoil removal difficult. According to Miller, cleaning out the spoil was the most challenging portion of the job. The spoil removal adapter helped, but with rocks ranging in size from softballs to basketballs, it's easy to see why it was so difficult.

Miller's crew enlisted the help of a piece of equipment called a Dingo. The Dingo is a one man mini skid steer manufactured in Australia.

The last 20 foot segment was rammed in on June 6th, bringing the total to 160 feet and bringing to an end the biggest pipe ram of Miller's career, so far. The project took, from preparation to clean up, just 12 days.

Gigantic projects call for a superior technique

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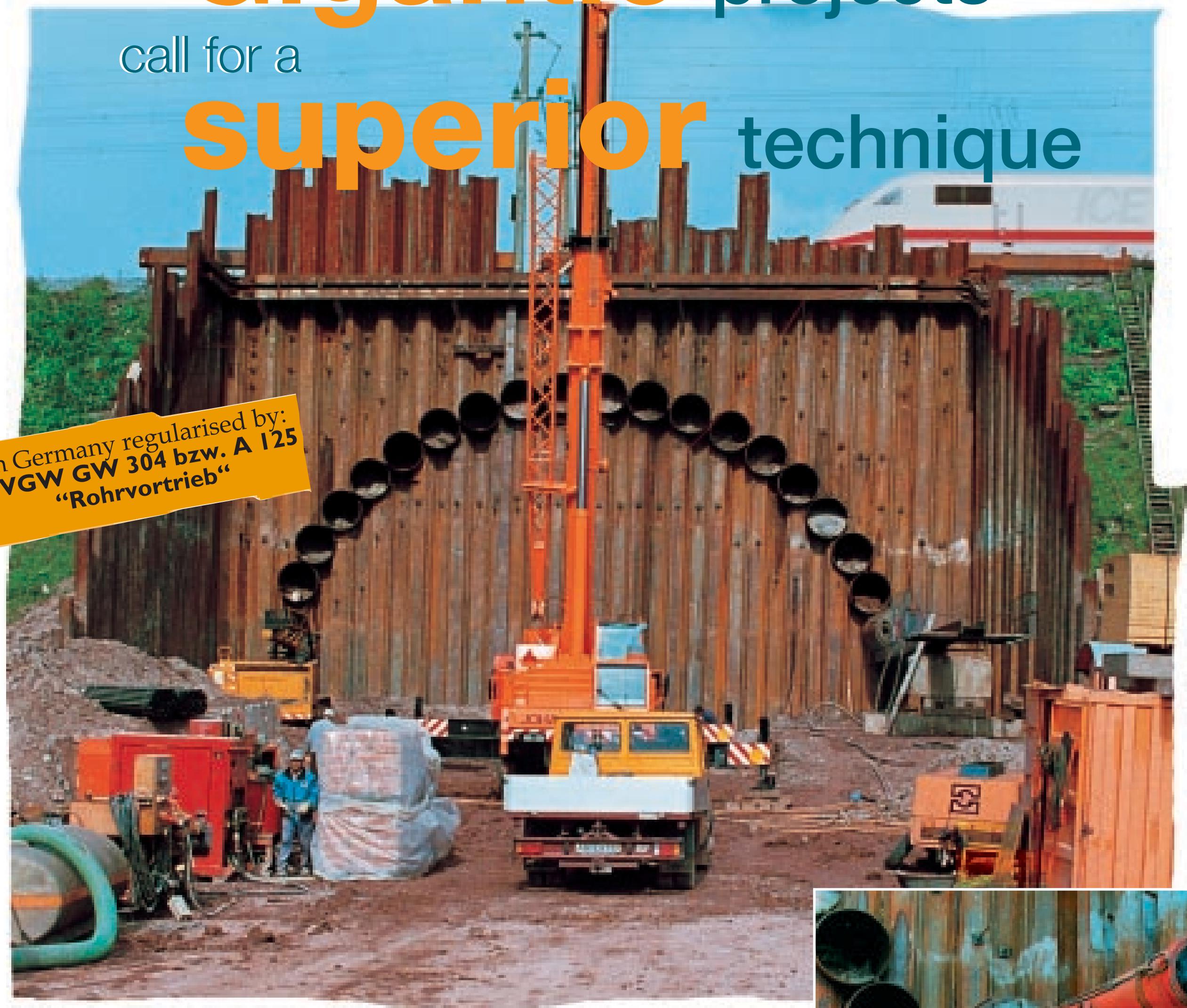


Spectacular tunnelling project near Emskirchen / Germany using the GRUNDRAM technique.

Precision task for GRUNDORAM.

As part of a major road building programme in Germany a tunnel had to be built underneath a high-sided railway embankment. Contractor Johann Potsch made a spectacular proposal to carry out this difficult task: 44 steel pipes should be installed to form a circular support structure for tunnelling beneath the embankment.

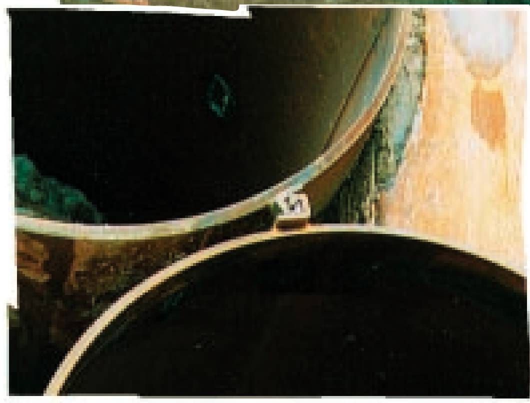
Calculations to carry out the job using traditional excavation methods or alternative hydraulic thrust boring equipment (requiring huge concrete jacking abutments) resulted in estimated total installation costs of several million D-Marks. However, the procedure proposed by contractor POTSCH offered considerable cost-saving benefits of almost 4 million D-Mark by utilising a tunnelling structure whereby a technique referred to as ‘pipe roof’ was employed.

Contractor POTSCH had submitted a scheme using the TRACTO-TECHNIK manufactured pneumatic steel pipe ramming hammers GRUNDORAM to install 44 steel pipes (a total of 550 m of steel pipe) of diameter 1.220 mm x 20 mm, each one installed next to one another, to form a complete circular support structure of steel pipes for tunnelling beneath the railway embankment.

The initial view of the tunnelling projekt.

Right: The complete circle of pipes in January 1995.
Below: "Topping out ceremony": TAURUS installing the last meters of pipe, December 12th 1994.

◄ 180 Dywidag threaded steel connections were used to stabilise the embankment.



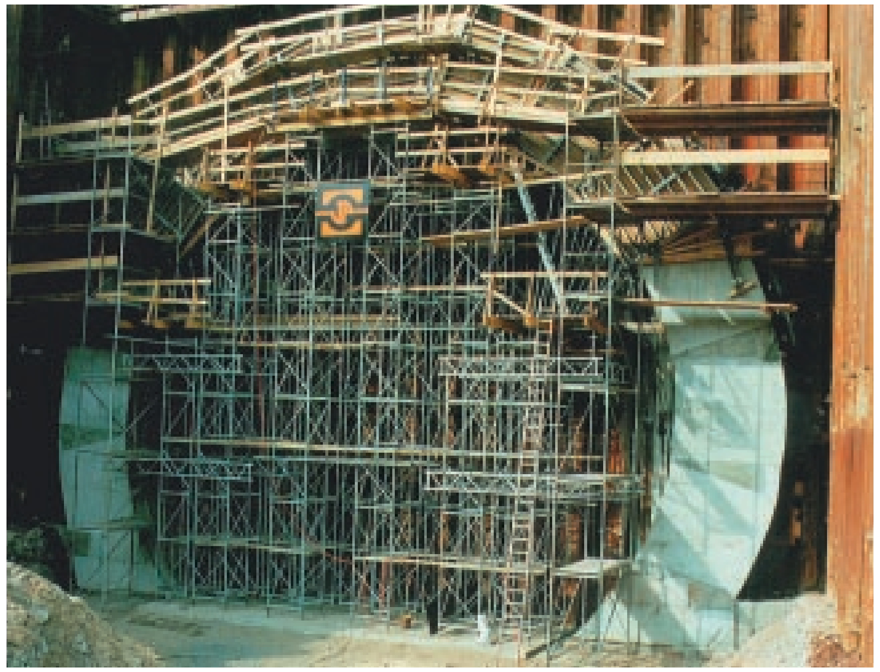
For exact alignment interlocking steel profiles were welded on each pipe.

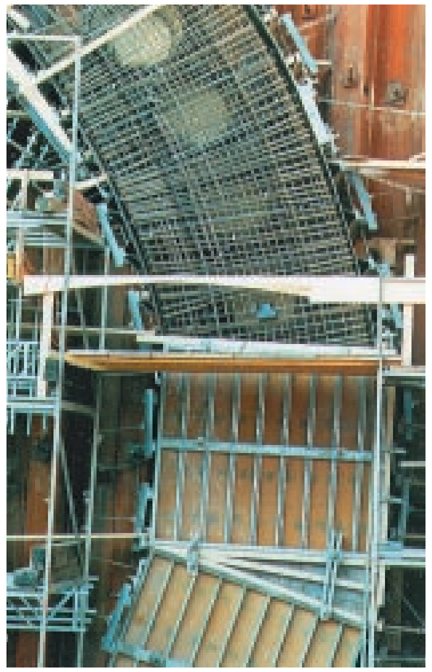
The decision to use GRUNDORAM equipment for this unique project was based on contractor Potsch´s past and positive experiences with this type of dynamic pipe installation equipment which requires very short set up times and almost no fixed pushing abutments - thereby saving on time, labour and material costs. In cooperation with the manufacturer of the equipment, TRACTO-TECHNIK, contractor Potsch studied past example projects whereby ‘pipe roof’ jobs had been carried out in Korea using a GOLIATH 450 mm hammer. While semicircles of ‘pipe roof’ have been successfully used in Korea on numerous job sites beneath railway embankments, a full circular installation was a FIRST for all parties concerned.

In view of the soil conditions TRACTO-TECHNIK decided on using the most powerful machines in their range of steel pipe ramming hammers. The first pipes were installed using the GOLIATH 450 mm hammer although subsequently the majority of the pipes were installed with a TAURUS of 600 mm diameter, which develops up to 2.000 tons of dynamic thrust.

To avoid any deformation of the railway embankment, Arbed PU 25 steel sheet piles were installed vertically on each side of the embankment, forming a solid wall. To tie in the two walls of sheet piles a GRUNDOMAT 75 mm bored from

Left: Preparations for producing the concrete ring are in progress. The pipes have not been evacuated. The reinforcement steel bars protrude out of the sealed off pipes.
Right: This view shows the depth of the concrete ring.





These photos were taken in April 1995: You can see the concrete covered pipe circle and the visible part of the reinforced concrete ring.

one side of the embankment to the other, installing a total of 160 Ischebeck Titan steel tie rodding anchors. The preparations prior to the ramming process took about 20 weeks. During this time preparations were also made to produce a simple starting platform onto which the Taurus GRUNDORAM was positioned. A simple I-beam proved sufficient, which was individually positioned and welded onto the sheet piles for each steel pipe installation. As the pipe ramming project progressed, circular openings were cut into the sheet piling walls to form an entry hole for the 44 steel pipes.

The line and level of the first steel pipe was crucial as it had to be installed straight with 100% accuracy as the direction of the subsequent pipes depended on the precise installation of the first guidance pipe. The next and following steel pipes were prepared for ramming by welding interlocking steel profiles onto the outside of the pipes so that all pipes followed the direction given by the first lead pipe.

To transmit the full impact of the GRUNDORAM hammer onto the steel pipe and to keep plant requirements to an absolute minimum, a soil removal cone with lateral openings was installed between the steel pipe and the hammer. Due to these openings in the removal cone, the soil accumulating inside the steel pipe was partially evacuated DURING the actual pipe ram process, thereby decreasing the spoil weight and therby reducing internal pipe friction.

The wall is cut open in the center and excavating can begin.

The emptied tunnel. In the background you can see the coasting carriage for producing the concrete sections.

The single concrete sections (thickness 70 cm) were produced with supporting frames and a coasting carriage. Later the sections were pushed in with a hydraulic press. The carriage was loosened and driven out for the next section.

Two Demag air compressors of 20 m^3/min each were used. For each of the 44 steel pipes, the GRUNDORAM hammer was placed on its support cradle which incorporated an air cushion adaptor to adjust the height of the hammer at the flick of a finger. During pipe ramming the air cradle together with the GRUNDORAM and soil removal adaptor moved forward simultaneously until the total length of steel pipe was installed.

After the first semicircle of pipes had been completed, the project progressed by excavating the soil in layers as more and more steel pipes were installed until a full circle of 44 steel pipes was completed at a total depth of 8 m below the general ground level.

After the completion of the project, this excavation would be backfilled, compacted and graded back up to road level.

Pipe ramming speeds for each steel pipe length with a diameter of 1.220 mm varied from 2 to 6 hours per pipe length, depending on the soil type (which varied from clay to very stony soil). Daily measurements of the railway track did not show any alteration of the track level. The pipe circle is the supporting element of the tunnel. After completing this important stage of construction the preparations for the breakthrough could begin (see photos).

We congratulate contractor Johann Potsch on this outstanding engineering performance in the succesful completion of the project!

◀ The space between the outer and inner ring were later filled with concrete.

The tunnel after completion. ▶

Kolossal achievement

Special operation

'I'-beams rather than steel pipes using a GRUNDORAM Koloss ramming machine

As part of a road improvement scheme for Kent County Council, it was necessary to install 82 'I' beams varying in dimension from 775 mm to 975 mm x 460 mm x 15 mm in length to create the roof and side wall structures for a railway underbridge at Northfleet in Kent.

The initial temporary works involved sheet piling either side of the 10 m high railway embankment containing a 13.5 m section of track. The original scheme was to install 27 tie bars by directional drilling from sheet pile to sheet pile, a total distance of 14 m. Thirteen of these tie bars were to be used to contain the sheet piles and the embankment while digging out continued. Fourteen were used, again at different levels, for the reaction frame for hydraulic jacking.

Genseed Underground Services Ltd. (GUSL) of Chelmsford, Essex in England, a company specialising in trenchless technology, were contacted by the main contractor, Christiani & Nielsen Ltd. (CANL) for the directional drilling on this design and build project. On the initial site visit, after looking at drawings, etc., Genseed put forward the concept of ramming rather than jacking the interlocking 'I' beams using the GRUNDORAM technique. It is believed that this was the the first time in the UK that this method has been used on such a project. Extensive research was carried out to anticipate and overcome any technical problems that were likely to arise (a few were found lurking after the project sarted!).

GUSL contacted TT UK at Bedford with whom they have had an excellent working relationship for more than a decade operating Grundomat moles. After consultations, it was decided to purchase a Koloss ramming hammer.

The first five tie bars used to retain the top of the sheet piles were begun in April 2000 at 1.4 m below track running level. This operation was accomplished in two days, after which a further 1.6 m of earth was removed and a level platform provided from which the roof 'I' beams were to be rammed. The first two beams were 'clutched' together taking great care to attain the correct line and level as all subsequent beams were dependent upon them. Entry and exit holes were cut into both sheet pile walls and the ramming commenced. The first two beams took approximately one hour to ram with line and level well within specification.

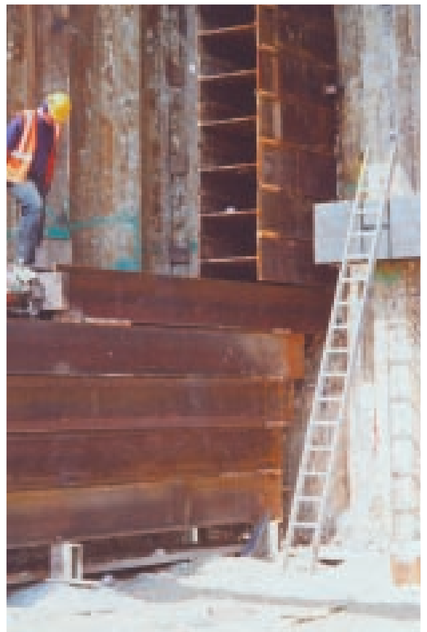
At the start of the third beam, it became apparent that there was a problem. By attempting to ram on the flange of a steel beam rather than a steel tube, some serious recoil problems were encountered. The normal ratchet straps were insufficient to contain the recoil force and so a special ramming plate, containing a tapered hole for the nose of the rammer and special fixings for the plate to the beam, was produced using a 75 mm thick armour plate. Once the problem of keeping the rammer in contact with the beams had been overcome, ensuring maximum energy transfer, each beam was installed in approximately 45 minutes.

Forty-two beams were installed in 12 days, which met the target of 3.5 per day. The beams were then welded to the sheet piles, through which they had passed, to stop the sheets from moving outwards. By the 8 May another 4 m of soil had been removed and another row of 4 tie bars were installed. An unforeseen problem arose at this stage because of the top row of beams. It proved impossible to track the head of the directional drill from above the ground. The task was made doubly difficult by the fact that the hole in the farther sheet was only 150 mm square. (The 'walers' that the tie bars were destined to be used on had been fabricated offsite so the accuracy was imperative.)

The near completed view of the total 82 'I' beams installed.

The overall jobsite view where the underpass road would eventually be excavated.

Each 'I' beam installed was carefully aligned using interlocking steel profiles.



The Koloss in full operating mode where on average each beam was installed in only 45 minutes.

This view shows the GRUNDORAM Koloss nearing completion.

Another satisfied TT customer!

GENSEED UNDERGROUND SERVICES LIMITED

By the 22 May the second phase of ramming for the side walls was ready to start. CANL, together with the help from GUSL, had had produced two walls, each containing eight 'I' beams lying on their sides and supported on a series of suspended pads. Ramming commenced from the top down using the next beam down in the stack as the guide for the ramming equipment. The last beam in each stack was driven from a set of rails mounted between the suspended pads. There were two more phases of beams installed using the same method, giving a total of 20 beams per side wall.

The last beam was successfully driven on 4 July 2000, a total of 25 days' (64 hours') ramming time to install a total length of 1.148 metres of 'I' beams. The works were completed 10 days ahead of schedule, thanks mainly to the reliabilty and power of the KOLOSS ramming hammer. The complete roof and wall beams were to within ±30 mm, which was well within specification. When taken back to TT UK's workshop for routine maintenance, a £50 'checkover' was all that was required.

Both main contractor CANL and GUSL were delighted with the successful outcome of the new joint venture.

Report from abroad

Record in Spain - Ramming specialist installs pipes Ø 1600 mm

The company Alcalser 2000 with its headquarters in Zamora, is better known in Spain for its building machinery renting business than for civil engineering.

It was 1990, when the company management decided to spread the company activities to civil engineering, specifically to trenchless installations. One first step was to buy a GRUNDORAM type HERKULES for laying steel pipes.

After the first good experiences, the company decided to also buy a GRUNDORAM type GOLIATH and the soil displacement hammer GRUNDOMAT type 130 mm.

Now Alcalser 2000 dared to carry out the more difficult steel pipe installation projects with more than 800 mm in diameter. Their experience and know-how was increasing with each and every application. Some time ago, Alcalser has been commissioned by the Ministry of the Environment (Ministerio de Medio Ambiente) for the underground installation of rain water pipes with a diameter of even 1.60 m.

The complete project consisted of:

1. 4 pipe installations, each one 60 m long, beneath a 4-line railway track
2. 4 pipe installations of 36 m length each, beneath a street
3. 5 pipe installations of 75 m length each, beneath a highway

In order to manage this job, Alcalser rented the strongest GRUNDORAM worldwide, type TAURUS, with approx. 20.000 kN thrust force, from the Spanish TT sales partner Sistemas de Perforación.

The first propulsion came to a standstill after 35 to 40 m, due to extreme coat friction. Complete immobility! Everyone was clueless at first, but then the company Alcalser decided to start propulsion anew from the other side of the railway track, exactly facing the stuck, half-installed pipe, intending to make pipe ends meet precisely beneath the track. A very courageous plan indeed, bearing a lot of risks.

But if there is a will, there is also a way. After careful preparation, the thrust began – and Alcalser made it, too. The pipes met with absolute precision, thus forming the desired 60 m pipe string. When soil removal with a mini excavator was concluded, the pipes were welded together from the inside.

The remaining installation jobs looked like child's play after this performance. Their self-confidence and the belief in their own abilities was unshakeable now. The street crossings were installed in the record time of only 4 weeks, including set-up time.

The last 5 pipe installations seemed to become the most difficult to perform with an unsteered pipe laying machine, due to their lengths of 75 m and their pipe diameters of 1.600 mm each.

But this job was also admirably completed. The first pipes, up to about 42 m length, were laid with their own GOLIATH pipe ramming machine, taking approx. 1 hour for 6 m. After that, Alcalser didn't want to take further risks, as coat friction of the steel pipe was rapidly increasing, and decided to use the TAURUS pipe ramming machine for the remaining meters.

The achievement of both machines fully convinced not only the building contractor Alcalser, his client was also impressed. Juan Peretó of Sistemas de Perforación, sales partner of TRACTO-TECHNIK in Spain: "This enormous achievement is a milestone for the future application of the ramming technique in Spain."

GOLIATH rams man-sized tunnel in mine

Debris heap of the caved-in St. Barbara tunnel.

Up to the beginning of the seventies, china clay was mined in Ehenfeld near Amberg Later on, the tunnel system, covering two levels with a length of 15 km, was closed.

1982, the tunnel entrance caved in. In 1995, the building contractors Riepl GmbH, Regensburg were commissioned to restore the accessibility of the tunnel for check patrols of the Board of Mines, Amberg.

The entrance of the tunnel was very cramped.

The length of damage along the track was to be determined with a soil displacement hammer. After 17 m, the operation failed, due to a hollow in the breakage. Observations on the surface lead to the conclusion, that the breakage covered a length of 40 m. An even greater length could not be totally ruled out.

At last, the company Riepl suggested the method they normally used successfully for steel pipe propulsion, the dynamic ramming method of TRACTO-TECHNIK.

The new plan was to press a steel pipe with 1.620 mm OD and a wall thickness of 16 mm through the heap of debris. The steel pipe, open in the front, was reinforced with a steel ring to avoid possible damage caused by buried trolleys.

The remaining trolley railway tracks were used as a rest for the pipes. In this way, the pipes could slide forward as if they were on skids. An old trolley served as a carriage for the ramming machine. Two compressors, together they had an air supply capacity of 50 cbm, were available. Seven pipes with 6 m each had been welded together as a string.

Looking through the advanced steel pipe. You can see parts of the crossing railway tracks clearly; they have been destroyed and pushed into the pipe.

Looking into the tunnel from within the advanced pipe. No one had set a foot into the tunnel for more than 12 years.

The GOLIATH proved to be the type of machine that was able to offer sufficient capacity reserves to drive in the pipe in spite of high resistance peaks and after standstill periods. The thrust was completed after 15 hours. The soil had to be removed by hand with a pneumatic hammer. The breakage reached its end after 30 m. The 40 m pipe was shortened to 30 m.

With a tunnel height of only approx. 1.80 m and a pipe diameter of 1.60 m, this propulsion operation could truthfully be called ”a neat bit of work”, and the Riepl company is rightly proud of it.

Steel pipe propulsion special

Due to open-cast brown coal mining in the Rhine area, which required lowering the upper free level of the ground water in parts of the fluvial plain, it was difficult to avoid natural long-term and harmful sinking of the ground, causing damage to the building.

In the least fortunate case, refounding the building would be necessary. The constellation of these problems lead to the development of the following pile system for subsequent deep foundation of damaged buildings.

This is achieved with special STB tie bars, running diagonally mainly in the corners of the building cellars and gripping underneath the existing foundations from below, forming a tight fitting connection. Next step is to press reinforced concrete ring segments (Ø 300 mm) through the holes in these tie bars right down to the well bearing soil layers by means of hydraulic. The load of the building, activated via vertical tension rods in the tie bars, serves as an abutment.

The conical steel pipe, vertically driven in by the GRUNDORAM, type MINI-OLYMP, to determine the pressure bearing capacity. The applied "wings" allow the next piece of pipe to be easily assembled and welded on.

The soil beneath the pile footing can be flushed out and replaced by concrete, if required, via the hollow core of the piled up concrete segments. Then the inner hollow of the pile is reinforced and filled with high-quality grouting mortar. In this way, a homogenous displacement pile with sufficient rigidity and stability is established.

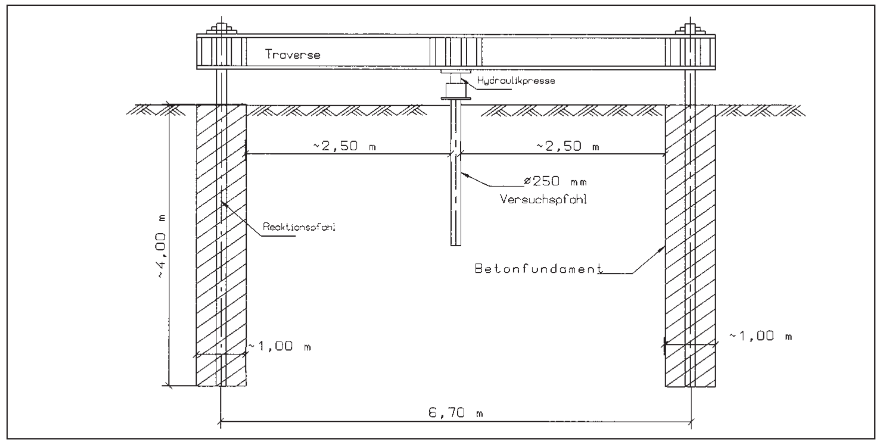
The steel pipe, already advanced and filled up with high-quality grouting mortar.

After hardening, the pile is burdened with 1.75 times the statistically determined working load and then connected to the tie bar, fitting tightly.

If the inclination of the building to one side has to be balanced, it is first lifted to its original horizontal position via computer controlled hydraulics; this happens by passing the powers of the pressing process via traction rod / tie bar construction directly into the building.

The method with concrete ring segments normally requires a sufficient building load for the hydraulic pressing process, which is not always available; for this reason, the following pile system version is a further alternative for a deep foundation.

With a ramming machine from TRACTO-TECHNIK, you can drive steel pipe segments (Ø 250 mm, l = 1 m), welded together, vertically into the building ground without abutment, while saving a lot of time. The lower end of the first steel pipe is shaped to form an almost closed point. Only small amounts of soil can enter the opening during propulsion. As soon as the pipes are installed, the soil can be extracted. Depending on the static calculation, steel pipes, differing in diameter (160 to 300 mm) and wall thickness, are required. As an alternative, the steel pipe pile can be reinforced and filled with concrete; the corrosion risk is eliminated, service life of the pipe is elongated.



Pile foundation in practice in the cellar of a house. The facing picture displays the hydraulic press.

Special operation

A Tree on the move!

The explosion of the atom bomb in Hiroshima marks a terrible date in the history of mankind. Hundreds of thousands lost their lives. Flora and Fauna were completely destroyed. Nothing was left to grow in the burnt soil. But there was one exception: a once impressing Gingko tree, which brought forth a new shoot in the following spring. But the Gingko has not only survived the atom bomb. As a botanical genus, it seems to defy time itself. Its origins can be traced back to 300 Million years before our time. With these facts in mind, it is not surprising to hear, that the Gingko is extremely suitable as a city grower, due to its extraordinary hardiness and resistance against harmful environmental influence.

Such a tree stands in front of the shell of the new administration building of the Landesbausparkasse Baden-Württemberg in Stuttgart.

Construction works have been going on for two years here. Due to the restricted space conditions, it was impossible to integrate the tree into the architecture of the new building, because the Gingko with its height of 20 m was growing directly in front of the new entrance, 3 m above court yard level. The building owner, LBS, kindly decided not to let "their Gingko" become food for the saw, but to transplant it 12 m away with the help of the latest know-how and technical aids. Wichmann, a company for horticulture and landscape design from Hofheim, specialised in transplanting large trees, was commissioned with the job.

Transplanting the Gingko with its weight of 150 tons.

The initial plan was to shape the roots into a ball 8 times larger than the tree trunk diameter. However, forced by the space situation, the root bale had to be made smaller. Freeing the wide-spread roots was performed with gentle care, to avoid unnecessary damage. After being shortened, the thick roots were smoothed and treated with root sealing agents. As a balance to the root loss, the crown of the tree was reduced by 20-25 % to suit its disposition.

Transplanting a tree of these dimensions was only possible after constructing a special transplanting basket, size 5 x 5 m, with a height of 2.50 m .

According to statistical calculations, broad flanged beams of various diameters were required for making the planting basket, the largest ones, HEM 500, with a weight of 270 kg per m. The problem would be to release the tree gently from the sub-soil and to close the transplanting basket completely around the root bale.

Pipe propulsion machine type OLYMP during propulsion (IPB 180 mm).

The Wichmann company contacted TRACTO-TECHNIK. A solution was sought and found in co-operation. HEM 180 beams were to be rammed into the ground along the complete broad side in a few centimetres distance. Then a total of 20 beams, each one 6.5 m long, was needed; on both sides, they were placed onto 2 HEM beams, where they were fastened by bolts under tension.

The pipe propulsion machine OLYMP, equipped with a special purpose-built reception to clamp itself to the beams, was put into action. The quantity of compressed air, approx. 5 cbm, required for operating the ramming machine, was supplied by a compressor. The parallel propulsion of the beams had to be extremely precise in height and sides and required exact setting-up and adjusting. The height of the beam was levelled with a spirit level. Several flat irons, fastened to the beams on both sides, allowed the direction to be constantly maintained, with a side distance of 8 cm. Each beam required approx. 30 min. propulsion time. Considering the dry, heavy clay soil, which had to be displaced, this good propulsion time was astonishing; in the course of the job, it was even improved by extra lubrication of the beams.

During the whole length of time needed for preparation, the gingko was secured on a stable auxiliary fastening construction made of foundations and iron beams. The event everyone had been waiting for took place in the afternoon of the 29th of March, 1993. Two heavy cranes (350 and 200 t) stood in waiting to transplant the tree. Now all depended upon the sensitive touch of the crane operators. The tree cage, with two hang-on points on each HEM 500 beam, was lifted slowly and without any problems and placed into the freshly prepared cultivating pit. This was truly a masterpiece, which was celebrated with a glass of bubbly wine for all persons involved.

Installed IPB beams 180 mm lying on IPB beams 500 mm. The short beam part welded on is intended for beating out the beams after transplantation.

Tree care is planned for the next four years at least. After soil analysis, fertiliser will be mixed correspondingly and applied 2-3 times a year. Later on, when the root system has regained its old strength, it will be able to supply the assimilation organs with the optimal nutrition dissolved in water.

Gigantic performance

When buildings are constructed on sandy soils, soil stabilisation works are generally a costly part of the entire building. Inhabitants from the nearby capital Santiago have made Viña their favorite seaside resort, an escape after a hectic week in the exploding city of Santiago.

Contractor Servicios de Perforación in Viña was one of the first to invest in a GRUNDOMAT soil displacement hammer for house connections some years ago.

Having used his 260 mm pneumatic hammer for installing sheet piles for stabilisation of sandy slopes in Viña del Mar last year, he came across a contractor that was busy installing sheet piles using Demag sheet pilers. A total of 3.000 piles had already been installed using 4 Demag vibrators. As the soil was not only sandy but also contained a considerable amount of stones and gravel, the deformation of the first sections of the sheet piles was so enormous that one crew was engaged full time to recondition the sheet piles for further use on this sewage pipe installation project. Depending on soil conditions a total of 1only 3 to 20 sheet piles were being installed on a daily basis.

William Wright proposed to continue the project using his GIGANT rammer with the hydraulic sheet piling adaptor, an expensive item that can be easily attached to the rammer. Shortly after coming in as a subcontractor, 80 sheet piles per day were installed. The Demag vibrators were put to rest and just one crane and one crew was required to suspend the Gigant rammer and to work on the jobsite. In just 56 working days a total of 6.000 sheet piles had been installed, the scheduled operation deadline had been undercut by 20 operating days, coupled with enormous cost-savings on the material and the availability of labour on the site. Altogether a fascinating operation terminated to the complete satisfaction of the contractors and the sewage company concerned.

Combined application

HDD Unit GRUNDODRILL installs size 600 steel Pipe supported by GRUNDORAM

Immediately before pulling in the pipe. The pipe string is connected to the backreamer.

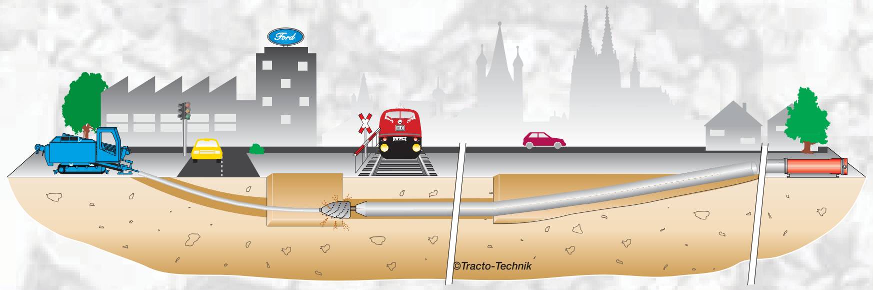
The GRUNDODRILL 20S in action.

Commissioned by the GEW, Cologne, 10 km of a new high-pressure gas line had to be installed in Köln-Niehl. Within the scope of these measures, the LTG, Neuss, was commissioned to install the high-pressure gas line in a 180 m long section near the Ford Works, Emdener Straße, applying the horizontal fluid assisted directional GRUNDODRILL boring technique. Located within the area of the bore path are a street crossing, railway lines and a bridge building. Indicated installation depth was 5 m.

It was not planned to pull in the size 400 media pipe directly, in order to avoid any possible damage to the PE coating. As means of protection, the decision was made to first pull in a 600 x 8 mm steel pipe instead.

The steel protection pipe string, ready for use (10 single lengths of 20 m each, welded together), with a pipe weight of approximately 1.8 t, lay out in readiness, a specially fortified bumped boiler end welded to the front of the pipe.

The KOLOSS pipe ramming machine at the end of the pipe string.



The pilot bore and several expansion bores took approx. 2 days to complete. Then the pulling-in of the pipe could begin.

The pipe end was equipped with a KOLOSS pipe ram, to ensure further support at hand, should obstacles or strong jacket friction occur. It would be able to pass on dynamic impact power to the pipe string, comparable to the pilot boring process, where the impact unit of the GRUNDODRILL passes on its power to the drill stems.

The "space" between pipe and backreamer took over the function of a buffer, in case the impact of the ramming machine should push the pipe string forward faster than the GRUNDODRILL could pull it in.

Pulling in the pipe commenced smoothly for a length of 160 m without a hitch. Traction speed amounted to 25 m/h. Apparently, the assistance of the ramming machine would not be required. The traction capacity remained continually 100-120 kN (10-12 t), thanks to the careful preparation works, until about 20 m before reaching the target.

Collapsed foundation remains were probably the reason, why the pulling-in process was vehemently stopped at the 160 m mark. In spite of further increase of the traction power, the obstacle could not be surmounted; the ramming unit was forced into action at last. Finally, pulling-in speed achieved 10 m/h again.

Special application

TAURUS: Pipe roofing in Korea

Korean Contractor, Sangshin Construction was faced with the task of installing three water pipes of ND 3.000 mm under a busy motorway as part of the 'Water Supply Expansion Plan for the Seoul Metropolitan Area'. With the Korean T.T. sales partner, CE Incorporated from Seoul, the project of pipe roofing, using a GRUNDORAM pneumatic steel pipe rammer was discussed and the solution approved by the Motorway administration.

It was decided to use the proven method of pipe roofing and to install 39 steel pipes of a 508 mm outer diameter (20") under the total width of the motorway of 34m (104 ft). These steel pipes were interconnected by special profiles over their entire length, thus forming a rigid structure, acting like a roof. In cooperation with the TT Group, Sangshin Construction studied past example projects whereby "pipe roofing" jobs had been carried out in Korea using GOLIATH 450 mm hammers.

The contractor purchased a GRUNDORAM TAURUS, capable of 2.000 t of dynamic thrust, for this project. This machine is the biggest machine of its type, available in all of Korea.

Under the careful supervision of a ramming specialist from Germany preparations were made to produce a solid starting platform (length = 20m (60ft); width: 25m (75 ft) made of H-beams, onto which the GRUNDORAM TAURUS was positioned. The line and level of the first steel pipe was crucial as it was essential that it was installed straight with 100% accuracy, as the direction of the subsequent pipes depended on the precise installation of the first guidance pipe. To guarantee the perfect arrival of the first pipe, a GRUNDOCONTROL level measuring system was used on this job.

To transmit the full impact of the GRUNDORAM hammer onto the steel pipe and to avoid flaring of the steel pipe, TT manufactured 4-piece cotter segments were used to adapt the size of the GRUNDORAM hammer to the diameter of the steel pipe. Cotter segments are designed for ease of positioning and handling. A grade of 0.5% was used for the first pipe which was accomplished by the respective engineering firm. For the first pipe just one air compressor was used which is normally insufficient to obtain optimum impact energy from the rammer.

However, in this case it was considered sufficient and the first pipe section of 12m (36 ft) was installed in just 30 minutes; the next 12m in 1 hour while the final section required 2 hours. When the grade of the first pipe arriving in the target pit was accepted by the engineering company, an additional compressor was then used.

With each additional pipe being installed, the operators gathered more experience in the use of the GRUNDORAM equipment and soon two complete pipe lengths were installed to the entire satisfaction of the Motorway authority and Sangshin Construction. The final structure of the 39 interlocking steel pipes were to be buried again, to support any probable ground settlement which was expected when the final water pipes of ND 3.000 mm were to be installed.

The three water pipes ND 3000 above which the "pipe roof", consisting of 39 steel pipes interconnected by special profiles, was installed.

Soil removal

The basics of soil removal with compressed air after ram driving

Soil removal cone for automatic removal of the soil during propulsion (partial removal during propulsion).

Steel pipe propulsion with the GRUNDORAM is a widespread, economical, simple and "popular" pipe laying method, well tried for more than 20 years and now, at last, admitted to the A 125.

After completing pipe propulsion, the spoil has to be "taken out" of the thrust-in pipe. This can be done with one of the following methods:
1. Removing the soil core applying water pressure or in combination with compressed air
2. Removing the soil core in one piece applying compressed air
3. Removing the soil applying augers, water jetting or suction dredgers or manual methods (in man-size pipes)

As compressors are normally used on the job site, soil removal with compressed air is a practical, but rather dangerous method, which may only be performed, if the high safety requirements are acknowledged. For this reason, the responsible resident engineer has to check out possible risks and take corresponding safety measures. Always make sure, that

1. no compressed air is applied for the soil removal of pipes >DN 500
2. soil removal with compressed air is avoided in the central city region and in residential areas, otherwise special protection measures must be taken.

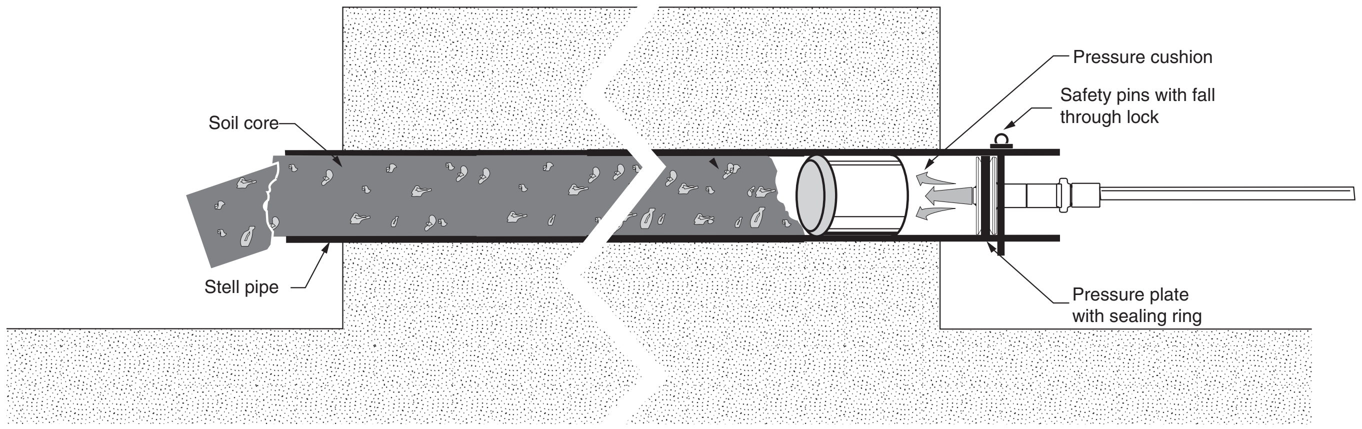
The German Ministry for health, work and social affairs, Düsseldorf, had been trying to prohibit soil removal using compressed air. In order to ward off general prohibition, TRACTO-TECHNIK commissioned an extensive expertise. With this, TRACTO-TECHNIK achieved the permission for further appliance of the compressed air method to remove soil from pipes. The soil removal system falls under the machine guideline, which places certain demands upon the performance.

For example, the propulsion pipes, welding seams, pressure plate, fittings and hoses must be able to bear at least twice the pressure that is being passed on to them. By guarantee, a pressure of 7 bar must not be exceeded. Also, additional personal protection measures have to be taken.

The additionally required and tested equipment for soil removal with compressed air is available from TRACTO-TECHNIK, including detailed setting-up instructions.

Soil removal with compressed air requires qualified personnel. Therefore, TRACTO-TECHNIK offers special training for soil removal with compressed air.

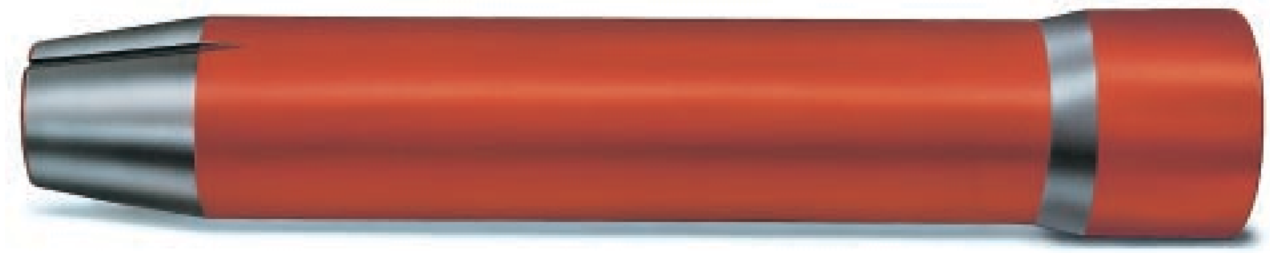
However, the responsibility for an appropriate and proper use of the system lies with the user exclusively.



Information

High Quality

...for taking a lot of wear and tear!



Quality is not merely a slogan for us, but a constant challenge to improve our products for the sake of our customers. We are focusing on sound technology with the features robustness, durability and longevity. Good examples for this are the GRUNDORAM pipe ramming machines, consisting of only 3 main parts:

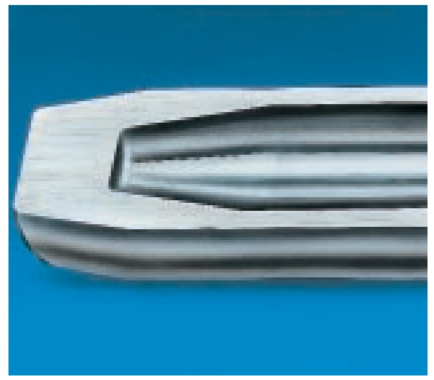
1. The housing is in one part, manufactured from one solid forged steel block, in other words, there are no weak or wearable connection parts.
The running face of the piston in the solid casing block is hard chrome plated to minimise the surface wear and increase corrosion protection.

Lathing of a GRUNDORAM piston.

2. The piston, having to endure extreme strain, is hardened elaborately. This guarantees highest wear resistance. Electro-galvanising is one further tempering step to fortify protection against corrosion. Several sliding belts bear the heavy piston, allowing it to move freely, thus avoiding the strong wear caused by metal-upon-metal friction. Sealing rings minimise air consumption and increase the capacity, which leads to higher efficiency – and large capacity reserves.

3. The flexible control stud suspension is positioned exactly in the piston centre. The stroke impulse of the piston, which is transmitted to the control, is cushioned to go easy on the material. A constant load is no problem, because there are no screw connections. The control with the elastic aeration block is fastened to the machine body with the segment ring. The TT pipe ramming machines are the only ramming machines that can do without the otherwise common screwed connections. The connection hose can also be exchanged quickly, simply and problem-free without swaging. All these points, together with the optimal co-ordination between piston weight and stroke, make mobilisation of all power reserves possible – even up to 2.000 tons for the TAURUS.

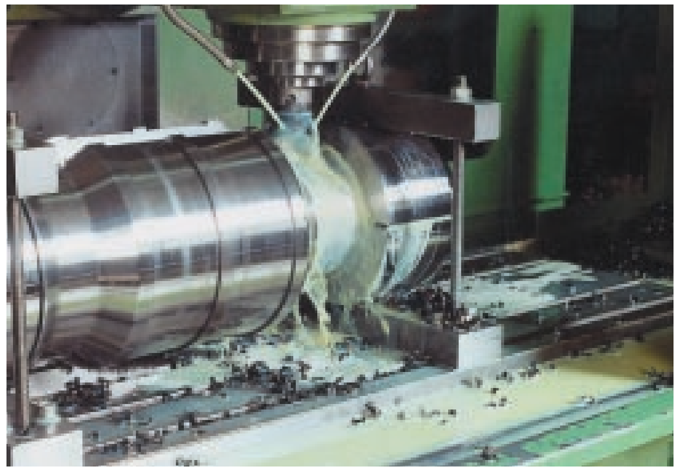
The ramming machine doesn't need the usual thread connection.



The solid machine body is forged out of a single piece.

Information

Service for machines and accessories: Quality to compare with the best



Having a tolerance of only 0.05 mm, the clamped work piece can be milled and drilled with extreme precision.

Linked to the CAM system, this machine can guarantee highest flexibility and quality in production.

In comparison

The true value of the GRUNDORAM-rammer...

... becomes obvious when you look at the propulsion capacity, which depends upon the soil quality, pipe diameter and length of the pipe installation. Coat friction and front resistance have to be overcome. The TRACTO-TECHNIK rammers have sufficient power reserves to guarantee high propulsion capacity.

Quality pays off.

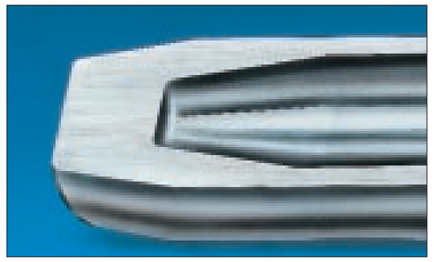
That is why we put so much weight on the impact capacity, reliability, robustness and longevity.

Look at the check list and find out, whether cheap products or plagiarisms fulfil the same preconditions required for all applications. Also be careful with cheap repairs, which are carried out without the original spare parts.

Quality and service	TT			Your advantage
machine housing in one single part no part are screwed together	✔			high load-bearing capacity / longevity / no weak points
small number of machine components	✔			robust, minimum wear
optimal piston weight/stroke	✔			optimal power conversion highest possible power development thrust force up to 2.000 t
flexible suspension of the control matic centring in the piston	✔			elastic / material-saving transmission of power
specially hardened piston	✔			wear-resistant and extremely durable
piston galvanised	✔			corrosion protection
sliding belts bear the piston	✔			no metal-upon-metal friction
piston surface hard chrome plated	✔			less surface wear, corrosion protection
optimal sealing technique	✔			modest air consumption
high-quality compressed air hose	✔			longevity
mini machines with rear cone	✔			in-pipe propulsion - even vertically
accessories for soil removal	✔			simple soil removal technique
soil removal cone or adapter (pat.)	✔			soil removal during propulsion
greasing technique	✔			coat friction reduction of the pipe
pneumatic lifting cushion	✔			simple machine alignment
compressed air heater Maxitherm (pat.)	✔			applicable during frost spells, for all pneumatic tools
Training, free of charge	✔			a good way of gaining know-how
branches all over Germany	✔			customer proximity
rapid spare parts delivery, 24 h service	✔			minimal standstill periods
applicable in many ways	✔			e.g. for ramming sheet pilings
35 years of know-how	✔			experience and competence

Information

GRUNDORAM offers more power



When pushing steel pipes up to ND 2000 yan extremely rugged machine technique is employed. GRUNDORAM has been designed and constructed to work in these toughest of conditions - plus many other operational advantages.

1 Casing
The one-piece casing (head and casing are one part) is made out of a solid block of alloy steel, offering minimum wear and tear and material fatigue.
Advantage: extremely good anti-corrosion properties, long life expectancy, minimal maintenance.

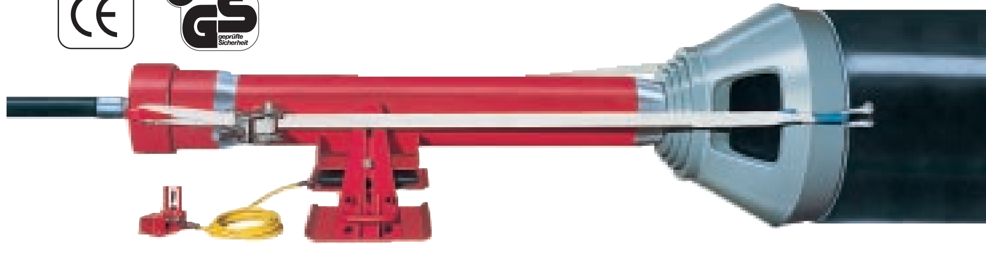
2 Control stud
The control stud is held centrally in an elastic shock absorbing housing which automatically aligns itself inside the main piston. The recoils from the piston impacts are cushioned and therefore protect the Component parts from overload. The robust control stud is plated in the same way as the piston to guarantee good anti-corrosion properties.

3 Compressed air hose
The connection hose can easily be exchanged.
Advantage: hoses can be simply screwed on with no weak connections and easily be removed whilst in transmit.

4 Ratchet
Flexible and extremely tough fabric strops and ratchets for securing the machine behind the pipe - important for easy alignment and stability during the bore.

5 Piston
Being the main moving part of the hammer, the piston is subject to incredible stress from impact power blows and GRUNDORAM's increased stroke frequency. Therefore, it has to be particularly resilient. Due to the special heat treatment, the piston and material properties are optimised with the highest possible anti-corrosion protection together with the combined strength and durability.

The robust piston has interchangeable teflon seals thus abrasive metal to metal friction and subsequent internal wear is avoided, whilst keeping the air consumption to a minimum yet maintaining the full efficient impact power.
Advantage: high impact power, with plenty in reserve, e.g. after standstills or when overcoming high resistance.



6 Air cushion
Special adjustable cradle air cushions (patented) can effortlessly raise and lower 3 tons of weight. The machine can be aligned exactly behind the pipe.
Advantage: takes out the effort and saves time when aligning heavier machines.

7 Ask for our regular certified free training courses available from our own trained technicians.

8 Soil removal
The safest and easiest way of removing spoil from inside the pipe after completing the ram job is by using a pressure plate, which is connected to the compressor and the spoil can be removed with a combination of compressed air and/or water. Special design high pressure pumps are available for these purposes.

9 Compressed air heaters
When temparatures drop below 0° C all pneumatic tools tend to freeze. This can even cause a total jobsite standstill which means increasing costs. There is only one solution: simply connect a Maxitherm compressed air heater (air flow 3 cbm/min) between lubricator und GRUNDORAM to warm up the working tools.
Advantage: all pneumatic tools can be used even when frost sets in.

10 Ram cones, soil removal cones, cotter segments
The machine can be adapted to match the diameters of most steel pipeswhich are required to be installed. The window openings in the removal adaptor enable the soil to escape (patented) whilst ramming processes. Pipes can be butt-welded together when using the set of cotter segments.
Advantage: adaptable to all common pipe diameters, optimum control of the impact power.

11 Versatile applications
With GRUNDORAM you have a complete system for each and every application of steel pipe ramming up to 2.000 mm Ø. The system is applicable both for horizontal and vertical ramming jobs e.g. sheet pile pulling and ramming.

12 Interested in our steerable boring systems GRUNDODRILL or our pipe bursting system GRUNDOCRACK?
If so, we could send you our latest brochure and/or a video tape.