




CONSTRUCTION OF UNDERGROUND ENGINEERING LINES

DEVELOPMENT OF THE UNDERGROUND SPACE. STRATEGIES OF THE 21-st CENTURY



CONCERN KPSB LLC IS ONE OF THE LARGEST COMPANIES OF UKRAINE, FOR MORE THAN 70 YEARS IT IS ENGAGED IN CONSTRUCTION OF UNDERGROUND ENGINEERING INFRASTRUCTURE.

THE CONCERN IS IN POSSESSION OF INNOVATIVE ENGINEERING METHODS, MODERN EQUIPMENT, POWERFUL PRODUCTION FACILITIES, HIGHLY SKILLED AND EXPERIENCED PERSONNEL.

WE IMPLEMENT LARGE-SCALE CONSTRUCTION PROJECTS IN COMPLIANCE WITH INTERNATIONAL QUALITY STANDARDS.

MISSION

We create a vital part of cities, namely: underground infrastructure, we establish conditions for better and comfortable life of people.

TARGETS

Creation of modern technological and technical basis for construction of underground infrastructure in Ukraine.

Working out solutions of complex engineering tasks with application of various production methods of construction of underground utilities.

Proliferation of experience for the purpose of development of underground construction in Ukraine.



History

1936

Start-up of Concern's history: «Hidrodorstroj» Office is organized, which was at the outset of construction of the first water mains in Kiev City and other underground structures, it strengthened slopes of the Dnepr River.

2000

Concern KPSB LLC, General Contractor is established. The Concern has embarked on a course of implementation and accomplishment of the newest engineering methods in construction of underground infrastructure of Ukraine's cities.

2001

Modern linear panel board supports have been purchased that are manufactured by EMUNDS und STAUDINGER GmbH, German company for pipeline laying using trench engineering method.

2003

For the first time in Ukraine the engineering technology of microtunnelling is applied for construction of main and street drainage pipelines. Works are carried out by AVN 1200 C HERRENKNECHT microtunnel panel board complex.

Together with partners, the manufacture is arranged of reinforced-concrete pipes of diameter from 400 to 1200 mm by vibrocompression method on the equipment of Pedershaab, Danish company.

2006

Vermeer D 36x50 (USA) installation is procured for laying the utility networks by a method of horizontal directional drilling.

One more AVN 1200 XC HERRENKNECHT microtunnel panel board complex is procured.

The new complex enables to carry out underground driving along difficult curvilinear routes for long distances.

2007

Henceforth, works are carried out in the conditions of dense urban development and preservation of historical landscape on a new Vermeer PL 8000 installation.

2008

For the first time in Ukraine, manufacture is arranged of reinforced-concrete pipes for microtunnelling with the polyethylene insert, as well as mantle pipes with diameter from 1200 to 2700 mm.

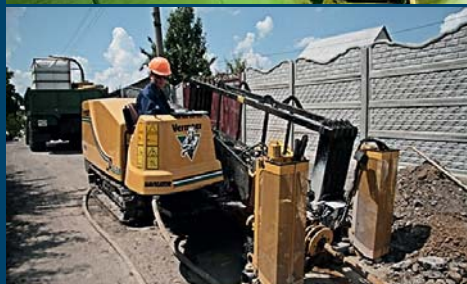
2009

Concern KPSB has received the Certificate on Quality Control System of GSTU ISO 9001-2001 (ISO 9001:2000).

For the first time, the modern engineering method is used of protection of ferro-concrete structures with a high pressure polyethylene in a water-sewer economy (construction of clear water reservoirs, inspection chambers etc.).

2011

Within the framework of program of engineering infrastructure development of the capital of Ukraine the Concern KPSB puts 11763, 0 km of engineering networks into operation.



Main kinds of work

- Work on designing the underground engineering networks
- Construction of main, street and intra-district engineering service lines:
 - drainage collectors of deep and shallow embedding
 - sewerage
 - water pipeline
 - heat supply
 - power supply
 - communication
- Restoration and reconstruction of functioning engineering networks
- Anticorrosive protection of metal and ferro-concrete structures against influence of harsh environment
- Special methods: constructional water drawdown, artificial soil freezing
- Construction of underground facilities: transport tunnels, storage reservoirs, parkings, etc.
- Manufacture of reinforced-concrete pipes

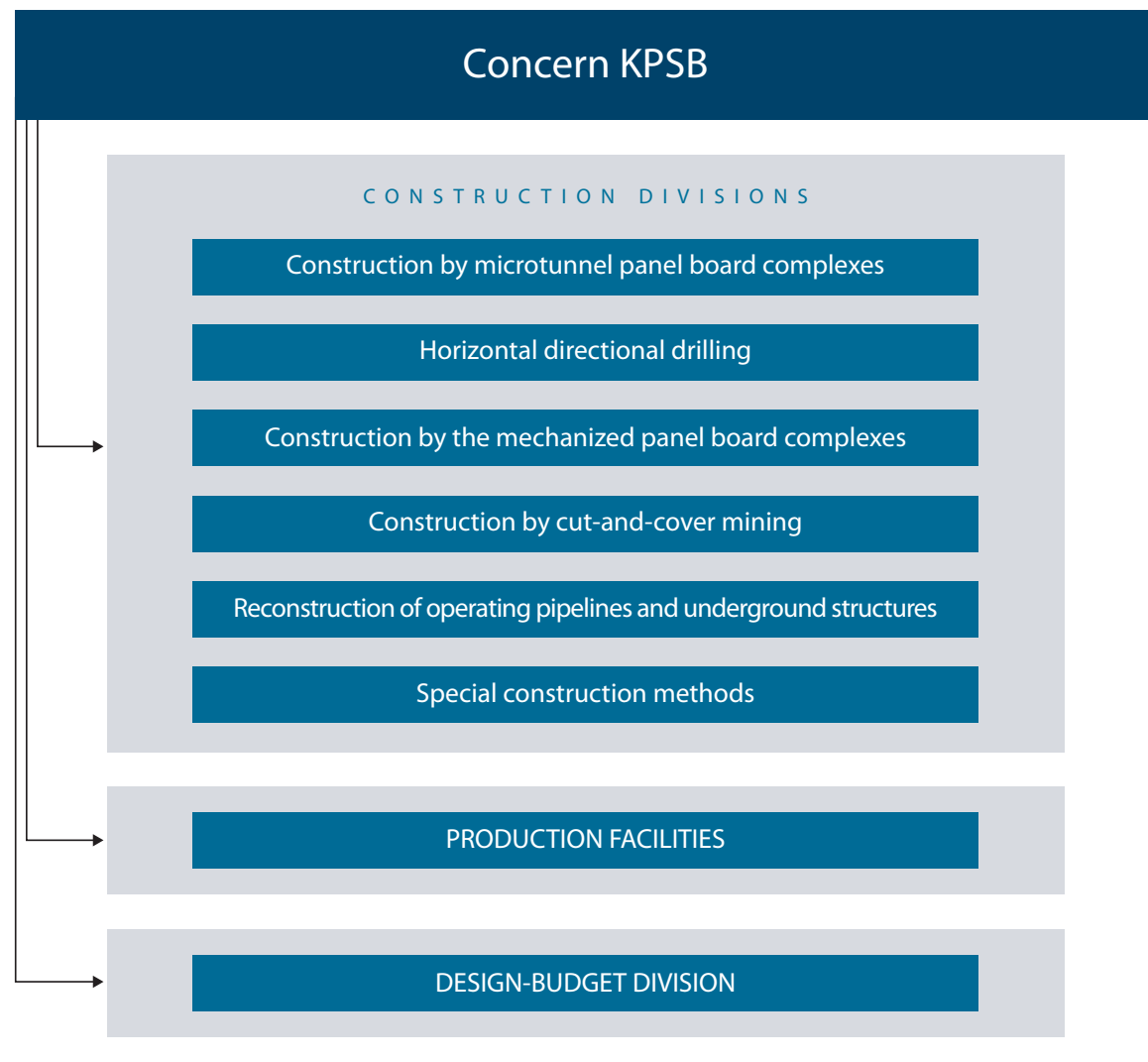


License AB № 040656 issued by the State Architectural-Construction Inspectorate of Ukraine on June 22, 2012, Order № 20-I



Certificate of Conformity of Quality Control System in work management in the sphere of construction to the requirements of GSTU ISO 9001-2001 (ISO9001:2000)

Company structure



Personnel

| | |
|--|---------------------------------|
| Total number of those working in Concern – 757 | Workers – 540 |
| | Engineers and technicians – 188 |
| | Management – 29 |

Concern's technological infrastructure

| | |
|---|----|
| Sets of equipment for tunnel driving | 14 |
| Vermeer horizontal directional drilling units | 2 |
| Emunds&Staudinger linear panel board formwork systems | 2 |
| Pump equipment for construction water drawdown | 40 |
| Vacuum water drawdown installations | 11 |
| Vertical drilling installations | 6 |
| Refrigerating machinery | 6 |
| Mining and shaft equipment | 4 |
| Automobiles, technological transport | 45 |
| Dump trucks | 15 |
| Excavating machines with scoop of various capacity | 15 |
| Automobile-mounted cranes | 8 |
| Loaders | 1 |
| Compressor plants | 7 |
| Diesel power stations | 10 |

Construction of engineering grids for 2000 – 2012

| Construction total amount equals | 274 566,6 lm |
|----------------------------------|--------------|
| Sewerage | 155 743,5 lm |
| Water pipeline | 82 765,0 lm |
| Storm water drain | 13 818,7 lm |
| Gas pipeline | 10 434,0 lm |
| Heat-supply systems | 8 215,3 lm |
| Electrical supply | 3 590,1 lm |

| Construction methods | |
|----------------------|--------|
| Cut-and-cover method | 64,36% |
| Shield driving | 18,58% |
| HDD | 6,79% |
| Microtunneling | 6,39% |
| Sanitation | 3,88% |

Concern's specialists have constructed more than 75 facilities by a total length of more than 270 km with depths of laying down to 90 m

1. Re-laying of pressure sewage collector from sewerage pumping station of Svjatoshin Residential Area. Length is 6220 m, diameter - 1000 mm.
2. Construction of new and reconstruction of functioning water pipeline from of Marshal Grechko Str. to the Greater Circular Road. Total length is 12362 m, diameter from 1200 to 1400 mm.
3. Construction of sewage collector along Stetsenko Str. Length is 3265 m, diameter - 1200mm.
4. Reconstruction of Vyborgsky sewage collector. Length is 2970 m, diameter from 1000 to 2000 mm.
5. Construction of new and reconstruction of existing sewage collector in Svjatoshinsky District of Kiev City. Total length is 4496 m, diameter from 300 to 900 mm.
6. Construction of Yugo-Zapadny sewage collector. Length is 9818m, depth is from 56 to 80 m, diameter is 2600 mm.
7. General Contractor's work on construction of all kinds of engineering networks: water pipe-line, household and storm water sewerage, heat-supply network, gas pipeline, telephone conduits at the reconstruction of road junction at Sevastopol Square.
8. Construction of sewage collector from Mostitsky sewage collector to the Main City Collector(1-st turn). Length is 4890 m, diameter - 1800 mm, depths from 9, 5 m to 63 m.
9. Construction of main water pipeline from Glubochitsky Str. to Vladimirsky Str. Length is of 2603 m, diameter is 900 mm.
10. Construction of a shaft for sewer pumping plant during the reconstruction of Kiev-Passazhyrsky Station Complex (Railroad Station Building).
11. Construction of sewage collector along Protasov Yar Str. Length is 1491 m, diameter is 600 to 1200mm.
12. Reconstruction of water mainline from the "Dnepr" Metro Station to Kirovogradsky Str. Length is 4617m, diameter is 1400 mm.
13. Laying of external networks of water supply and sewerage along Jaroslavov Val Str. and Gonchara Str. for Radisson SAS Hotel construction.
14. Construction of water pipeline, household and storm water drain, heat-supply network and gas pipeline during Majdan Nezalezhnosti reconstruction.
15. Reconstruction of existing water supply installations during construction of Water Museum in Hreshchatyj Park.
16. Reconstruction of Perovsky sewage collector. Length is 3320m, diameter is 600 to 1200 mm.
17. Reconstruction of sewage collector along Vossoedinenya Ave. Length is 1274 m, diameter is 1400 mm.
18. Construction of sewage collector along Zdolbunovsky Str. Length is 1132 m, diameter is from 315 to 1200 mm.
19. Construction of sewage collector along Bazhan Ave. Length is 1087m, diameter is 2280 mm.
20. Construction of a complex of artesian water supply installations of "Osokorki-Severnye" Residential Area. Construction of clear water reservoir.
21. Construction of sewage collector along Rossiyskaya Str. Length is 1611m, diameter is 1200 mm.
22. Construction of sewage collector along Alma-Atinskaya Str. Length is 4610m, diameter is from 200 to 1200 mm.
23. Reconstruction of Novo-Darnitsky sewage collector. Length is 1105 m, diameter is 2480 mm.





Engineering methods of construction of underground utility lines

Trenchless:

- horizontal directional drilling
- microtunnelling
- shield driving
- tunnel driving

Open-cut engineering method

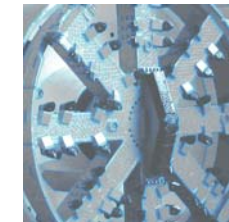
Trenchless engineering method of restoration and reconstruction of pipelines

Anticorrosive isolation of pipes and ferro-concrete structures with high pressure polyethylene

Our engineering methods:

- provide high quality of constructed facilities at a considerable economy of funds
- optimize work performance dates
- do not change city's usual rhythm of life
- preserve green zone and historical landscape

Construction activities by KPSB is an assurance of excellent performance of new and reconstructed networks for not less than 50 years



- Cost effectiveness
- High quality and accuracy of driving
- Reduction of work performance schedules
- Preservation of city’s usual pace of life

Microtunnelling engineering method

Since 2003, the specialists of Concern apply engineering method of microtunnelling at the construction of utility drainage collectors of various purpose.

The microtunnelling engineering method enables to lay service lines of diameter up to 3 m with continuous driving to 1000 m in any conditions that is especially actual at conducting work in big cities in the presence of newly laid utility lines, as well as in places of historical development. The given method is applied in any soils, beginning from water-bearing sands and finishing the hard rocks. The choice of a microtunnel complex depends on geological and local conditions and required diameter of a drainage collector.

At the moment, in Concern’s possession there are 2 AVN 1200 C and AVN 1200 XC microtunnel panel board complexes of HERRENKNECHT (Germany). Thanks to mastering of the given engineering method, we lay utility tunnels in difficult hydro-geological conditions at depths of 15 - 17 meters, diameter of 1200 mm. As of today, the Concern’s specialists have laid more than 20 km of engineering networks by a microtunnelling method.

Advantages of engineering method in comparison with traditional methods

- considerable decrease of volume of stripped and removed soil
- high speed of pipeline laying and reduction of work performance cost
- high safety of work
- possibility of pipeline laying along curvilinear route
- absence of influence of adverse weather conditions on time schedules and quality of carried out work
- preservation of natural and historical landscapes, as well as ecological balance in venues of work

| |
|---|
| Material of networks – reinforced-concrete pipes with anticorrosive polyethylene protection |
| Depth of laid networks – down to 17 m |
| Diameter of laid utility lines – up to 3000 mm |
| Distance between transfers – up to 1000 m |



- Designing on highest complexity tasks
- Self-containment and mobility of drilling facilities
- Fast construction rates
- Decrease of estimated cost of works

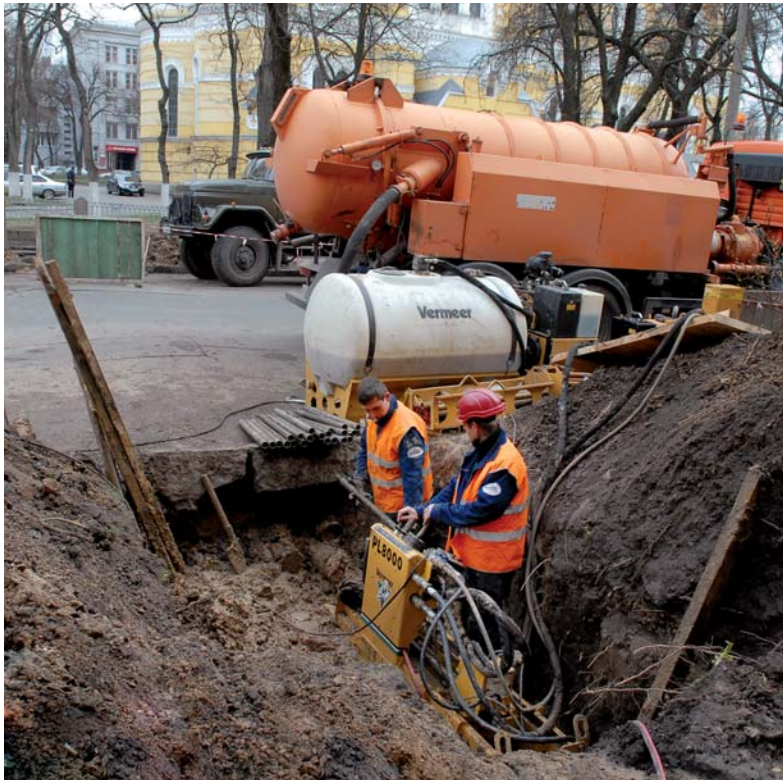
Horizontal directional drilling (HDD)

Horizontal directional drilling (HDD) is the modern trenchless engineering method which is widely used by specialists of Concern in construction and reconstruction of underground utility lines. In the property of Concern there are Vermeer D36h50 and Vermeer PL8000 drilling rigs manufactured by Vermeer, US company. Our specialists were trained at the facilities of the European representation of VERMEER Manufacturing Co., they have Company’s Qualification Certificates and they mastered HDD engineering method to perfection. By HDD’s method we lay engineering networks to 600 mm in diameter.

Advantages of HDD engineering method

- work in the conditions of dense urban development, including having historical value
- work in constrained areas where there is no possibility of use of excavation machinery
- preservation of natural and historical landscapes of parks and other «green» zones
- driving under rivers, lakes, without the wash-out of banks and bottom deposits of water reservoirs
- driving under functioning railroads and highways, flight strips of airports, in any territories saturated with functioning engineering networks
- laying of utility lines in territories of industrial enterprises, including in the conditions of functioning production process

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|--|
| Material of networks - metal, polyethylene |
| Depth of network laying – to 20 m |
| Diameter of laid utility lines – to 600 mm |
| Distance between transfers – to 400 m |





**Laying on
the extensive
depths**
**Large diameters
of drainage
collectors**

Driving by mechanized tunnellers

Shield driving is a traditional method of construction of service drainage collectors of deep embedding.

Specialists of Concern KPSB build drainage collectors with tubing liners at depths down to 90 m with interior diameter up to 2, 8 m, using PSh 3, 23 type tunneller

Advantages of shield driving

- driving tunnels at extensive depths
- large diameter of tunnels driven
- does not require day surface stripping, i.e. does not infringe usual pace of city life
- enables to preserve historical areas and historical landscape
- does not depend on weather conditions
- does not violate ecological balance of «green» zones

| |
|--|
| Material of networks: reinforced-concrete pipes and mantle pipes |
| Diameters of laid utility lines – up to 3 m |
| Depth of network laying – down to 90 m |
| Distance between transfers – to 2000 m |



High safety of excavation work
Acceleration of construction rates
Decrease of volume of soil moved out
Reduction of cost of work

Cut-and-cover method of engineering network construction

The ramified network of numerous engineering utility lines defines various methods of pipeline laying. It is not always possible and also economical to make use of trenchless method of construction.

Concern's specialists apply cut-and-cover method of engineering network construction using linear trench panel board formwork of Emunds und StaudingerGmbH, German company.

The linear formwork is appropriate for work in the conditions of dense urban development at depths down to 5, 96 m with pipes of large and small diameters. At the use of linear formwork the soil behind the trench edge remains stable thus enabling to work in immediate proximity of apartment houses and at the intense traffic on either side of a trench..

Advantages of cut-and-cover method of construction with application of a linear formwork

- high pace, simplicity and quality of trench arrangement
- fixed trench width at any stage of construction
- safety of walls and trench bottom lining
- integrity of soil outside the trench
- possibility of work performance at the bustling traffic and high loadings on either side of a trench

Material of networks – polyethylene, ferro-concrete, metal, ceramic and other kinds of pipes

Diameters of utility lines laid – up to 1700 mm

Depth of networks laying – down to 5, 96 m







- Expected life cycle- over 50 years**
- Guaranteed quality of potable water**
- Decrease in expenses for maintenance of structures**
- Ecological properties of materials**

Construction and reconstruction of clear water reservoirs and stilling pools

Specialists of Concern widely apply the newest engineering methods of construction and reconstruction of engineering networks and installations. Polymeric materials, polyethylene, corrosion-resistant coating of own development on the basis of epoxy resin are used for protection of ferro-concrete and metal structures against influence of hostile media.

The Concern for the first time in Ukraine has applied high-strength and safe-health polyethylene as isolation engineering method of clear water reservoirs.

Restoration of walls and inter-floor coverings of structures is made with application of high pressure polyethylene corrugated sheet. The material used is non-polluting and is in compliance with ENISO 1872-1 standard, has the certificate of conformity which have been issued by the State Center on Certification of Construction Materials and Structures, as well as the Hygienic Conclusion of the State Sanitary-and-Epidemiologic Inspection of the Ministry of Health Protection of Ukraine. The same material is used for a lining of water and sewage conduits.



Ecological compatibility – work is conducted without the day surface stripping

High chemical resistance of new pipelines

Reliable impermeability of drainage collector

Long-term service

Reconstruction of functioning pipelines

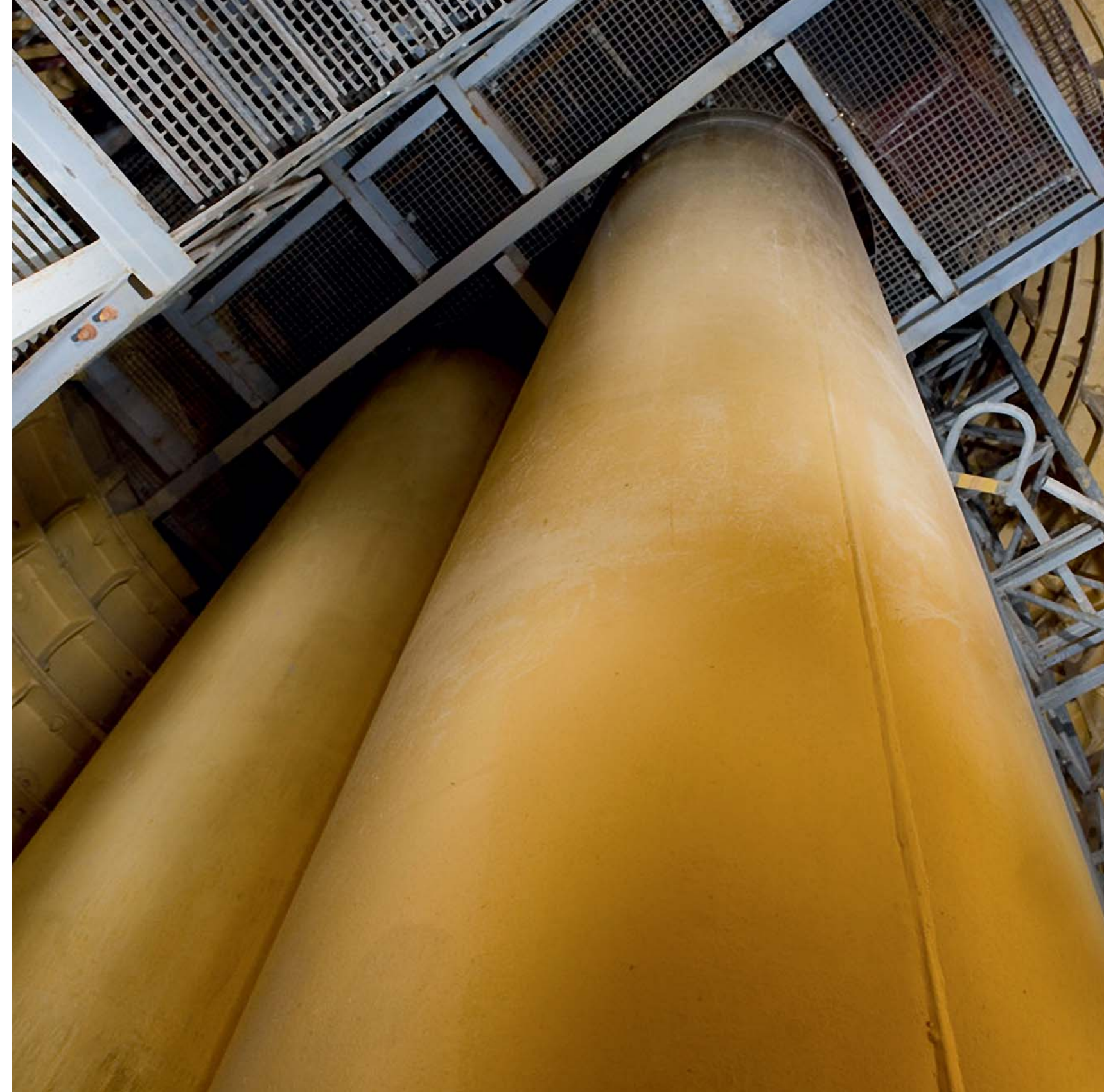
Since 2001, Concern carries out reconstruction of functioning pipelines with the application of trenchless engineering method.

Reconstruction of functioning pipelines of small diameter (from 100 to 400 mm) is conducted with methods of static and dynamic destruction of old pipeline and pulling-in a new pipe of larger diameter. Ceramic, metal and concrete pipelines are reconstructed in such a way.

Restoration of mains of large diameter (from 1000 to 2500 mm) is made by a method of pulling-in of SPIRO polyethylene pipe or reinforced-concrete pipe with polyethylene insert. Sanation takes place with diminishing of drainage collector diameter. Scope of application: sewerage networks, water conduits under transport highways, process water networks, meliorative systems, tunnels, reservoirs, cable encasements.

Advantages of engineering method use

- does not require surface stripping, soil excavation and removal
- does not interfere with traffic and pedestrian movement
- does not cause damage to environment
- does not depend on weather conditions
- provides extensive service life of drainage collector thanks to chemical durability of SPIRO pipes





Possibility of construction in unstable water-bearing soils
Safety of work in areas with difficult geology

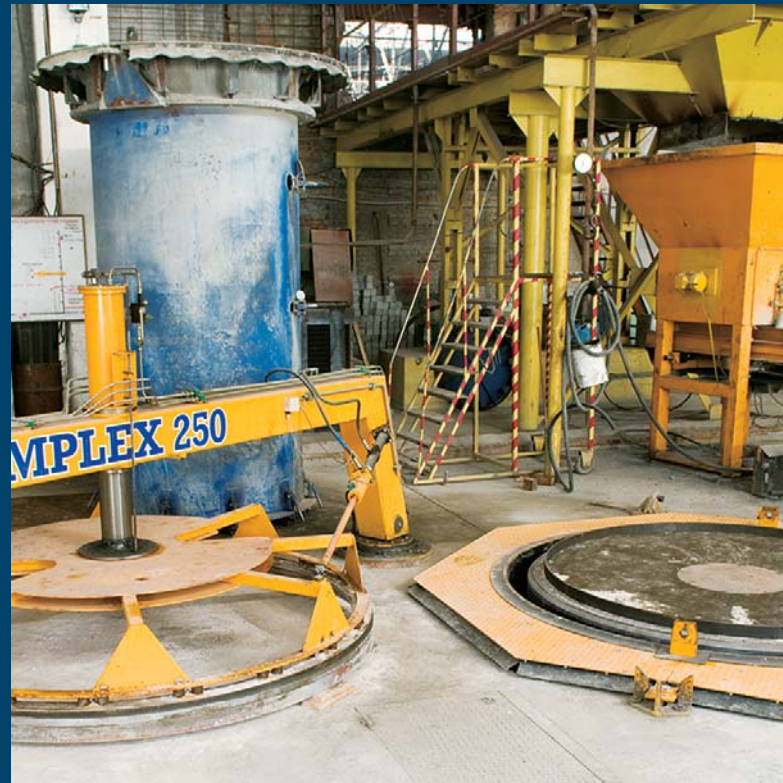
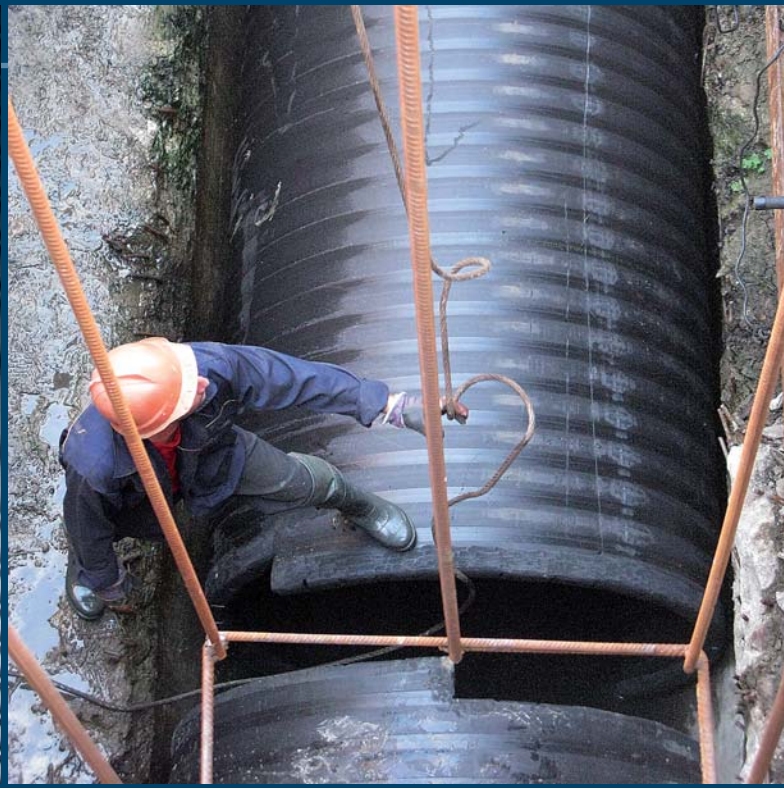
Special methods of construction

Constructional water drawdown is applied at the arrangement of shafts and trenches, in cases of water supply and water drain network laying in an immediate proximity of water reservoirs or in the conditions of water-flooded and unstable soils.

Specialists of Concern perform water drawdown in two ways:

- using YBB-3A-6KM vacuum water drawdown installations completed with well-points
- using well pumps mounted in dewatering holes

Artificial soil freezing is applied at the arrangement of shafts, tunnel driving, as well as at the construction of underground structures in weak unstable water-bearing soils. Method essence consists of creation of impermeable ice wallaround the future pitwhich withstands external hydrostatical pressure during performance of underground work.





High strength of pipes

Durability – service life for more than 50 years

Simple joining at placement of pipes

Ability to withstand high static loadings

High anticorrosive, frost and thermal resistance

Manufacture of reinforced-concrete pipes

Concern's specialists together with «Ingkomproekt» and «Trub-Ingbud» partner companies have developed and arranged the manufacture of:

- reinforced-concrete pipes for microtunnelling
- thin-walled ferro-concrete mantle pipes of D from 1200 to 2700 mm
- two-element pipes for intermediate jack station of microtunnelling engineering method

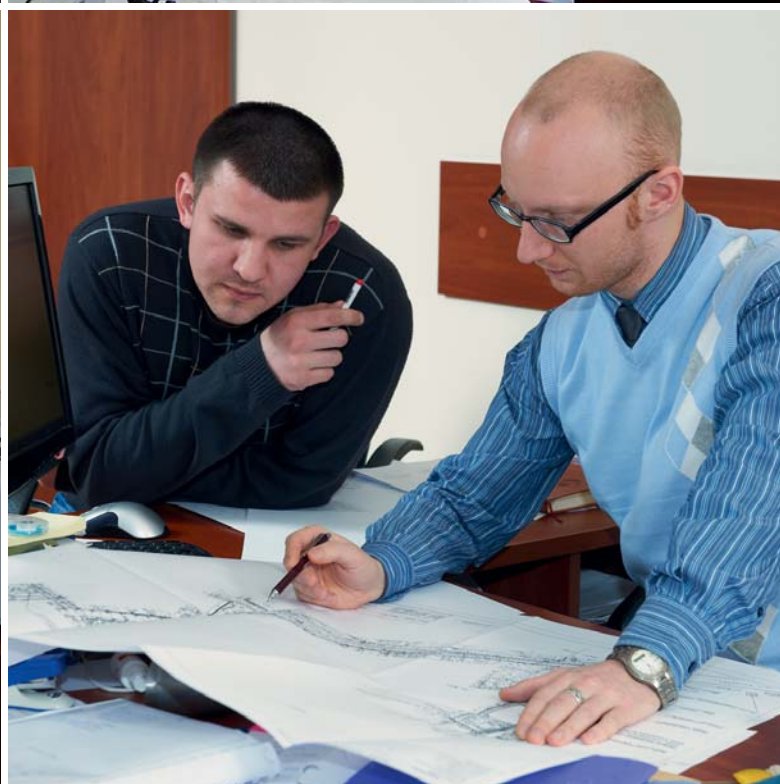
Two types of pipes are produced by vibrocompression method on the equipment of PEDERSHAAB, Danish company:

- with internal polyethylene insert (high pressure PE) for construction of gravity-flow sewage collectors and storm sewerage that receive aggressive flows
- without polyethylene insert for gravity-flow drainage collectors with nonaggressive flows and encasements for laying the pressure sewerage, water pipelines, gas pipelines and cable networks

Application:

- for arrangement of internal secondary lining of gravity-flowing drainage collectors laid with a method of shield driving;
- for trench-type laying of pipelines;
- for pipeline laying with microtunnelling method





Analysis of world experience
Generation of new ideas
Elaboration of integrated solutions

Designing

Concern's specialists in cooperation with «Ingkomproekt» Design Company are engaged in a complex designing and working out of design-budget documentation:

- designing of new construction and reconstruction of urban sewer and water supply networks, storm water inlets, including drainage collectors of deep and shallow embedding
- working out the designs of organization of construction with application of special methods, namely: water drawdown, freezing, cementation of soils
- strength calculations of underground structures on all kinds of possible loadings
- designing of system of urban water stations of water works facilities: clear water reservoirs, pumping plants of first and second lifting, systems of potable water decontamination by electrolytic installations, computer supervision over system's control operations
- designing of comprehensive maintenance of water and sewerage systems of urban territories
- working out the designs of power supply, automatics, teleautomatics, control of gas medium, scheduling of processes
- designing of transport tunnels

The Company advises the Customer on matters of design specification drafting, carries out designs of any category of complexity, all design stages, including: «Design», «Working Documentation», «Contractor Design»; conducts designer supervision over designs and carries out approval of designs in the relevant state organizations of Ukraine.

In design concepts there are used the most advanced construction technologies, i.e., microtunnelling, driving by mechanized panel board complexes with diameters from 2 to 3, 5 m, horizontal directional drilling, linear systems of strengthening the trench walls, vacuum and deep water drawdown, cementation and freezing of soils.

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