

PLANT MODIFICATION

Plant Mod. No.

1345-EE-L

Rev. No.

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INSTALLATION INSTRUCTIONS

Page No.

E2.2-1

SECTION E

CIVIL WORKS INSTALLATION INSTRUCTIONS

Underground Cable Ducts and Shafts

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1. Purpose and Scope

The purpose of this instruction is to provide requirements and guidance for the execution of civil installation works under Modification 1345-EE-L, Rekonstrukcija TP1 in kabelskih povezav 6,3 kV interne zanke (yard) in NEK.

This modification replaces existing equipment and the transformer in TP1 and establishes a new cable connection between TP1 and TP3.

To implement this modification, the following civil works and activities shall be performed:

- a) Reconstruction of the existing TP1 building
 - Provide new wall penetrations for the cable route through the TP1 exterior wall.
- b) Reconstruction of the existing TP3 building
 - Provide new wall penetrations for the cable route through the TP3 exterior wall.
- c) Reconstruction of existing shafts MHE04 and MHE05
 - Provide new wall penetrations for the cable route through the shaft walls.
- d) Installation of new cable routes
 - Install a new cable route from TP1 to MHE04 using concrete-encased PEHD ducts and manholes JE156, JE157, JE158, and JE159 at route direction changes.
 - Install a new cable route from MHE05 to TP3 using concrete-encased PEHD ducts and manholes JE160 and JE161 at route direction changes.

All installation works are classified as NSR, and no equipment or structures included in this modification require seismic classification.

2. References

The drawings and sketches referenced in this Installation Instructions are part of Section H of the Design Modification Package.

Additional appendices and supporting documents are provided in Chapter 329 of these instructions.

Other applicable SIST standards not listed in this chapter may be specified in the following sections of this Installation Instructions or in the associated Bill of Materials.

NEK procedures:

The referenced procedures are in Slovene language.

- a) ADP-1.1.033 Varstvo pri delu v NEK
- b) ADP-1.1.122: Izdaja, priprava in planiranje delovnega naloga
- c) ADP-1.1.125: Izvedba delovnega naloga
- d) ADP-1.1.051: Vstop, izstop in gibanje v tehnološkem delu NEK
- e) GMC- 4.004: Gradbeni odri

Legislation:

- a) Gradbeni zakon- GZ-1;
- b) Zakon o gradbenih proizvodih - ZGPro-1;
- c) Pravilnik o mehanski odpornosti in stabilnosti objektov;
- d) Zakon o varnosti in zdravju pri delu;
- e) Uredba o zagotavljanju varnosti in zdravja pri delu na začasnih in premičnih gradbiščih;
- f) Uredba o ravnanju z odpadki, ki nastanejo pri gradbenih delih;
- g) Uredba o odpadkih;
- h) Uredba o odlagališčih odpadkov;
- i) Pravilnik o projektiranju cest Uradni list RS, št. 91/05, 26/06, 109/10 – ZCes-1, 36/18 in 132/22 – ZCes-2;

Standards & guidelines:

- a) SIST EN 13670:2010: Execution of concrete structures;
- b) SIST EN 13670:2010/A101:2010: Execution of concrete structures - National Annex;
- c) SIST EN 13670:2010/A101:2010/AC:2017: Execution of concrete structures - National Annex Corrigendum AC;
- d) SIST EN 206:2013+A2:2021: Concrete Specification, performance, production and conformity;
- e) SIST 1026:2016 Concrete - Specification, performance, production and conformity - Rules for the implementation of SIST EN 206;
- f) SIST EN 10080:2005: Steel for the reinforcement of concrete - Weldable reinforcing steel General;
- g) SIST EN 12201-1-5:2024, Plastics piping systems for water supply, and for drains and sewers under pressure - Polyethylene (PE)
- h) Smernice in tehnični pogoji za graditev asfaltnih plasti TSC 06.300 / 06.410: 2009

Eurocode standards EN 1990 to EN 1999:

All applicable Eurocode standards, together with their latest published revisions, amendments, corrigenda, and relevant National Annexes, have been taken into account in the design and execution requirements of these Works.

3. Responsibilities

Responsibilities for installation works performed in accordance with this installation instruction shall be assumed by the Installation Company or the person designated in the work order. The Installation Company shall be fully responsible for all works performed in accordance with this installation instruction.

The Responsible Engineer (RE) from NEK ING.MOD is Rajko Petan.

Design Company: EKONERG d.o.o.

4. General requirements

The contractor's responsible engineers shall thoroughly review this procedure, perform a walkdown of the construction site, and review the construction drawings and existing site conditions.

The contractor's responsible engineers shall identify all elements included in the modification and verify the area required for installation activities. Prior to commencement of the work, a joint site inspection with NEK's responsible engineers shall be performed to identify and inspect all work areas associated with the modification. The availability of adequate space for the execution of construction and equipment installation activities shall be reconfirmed.

The responsible engineers shall ensure compliance with the technical requirements for installation works, equipment installation manuals, and all other relevant documents included in the approved design documentation.

Prior to commencing the work, the contractor shall familiarize itself with all applicable legal requirements and the investor's internal procedures relevant to the scope of these installation instructions. Attention shall be given to NEK requirements governing access, movement, and work execution within the NEK facility, as well as safety requirements for entry into protected areas. Installation works shall be performed in accordance with the approved drawings, technical specifications, bills of materials, and installation requirements.

All works within TP1 and TP3 shall be performed only after obtaining NEK's explicit approval to prevent personal injury or equipment damage. The requirements and conditions for work execution form an integral part of the project documentation and shall be fully complied with NEK.

The works will be performed within the existing NEK facility area, including TP1 and TP3, and in the immediate vicinity of existing operating buildings and facilities. The contractor shall strictly comply with the Safety Plan, the applicable provisions of the Construction Act (Gradbeni zakon – GZ-1), including all amendments, and with the safety engineer's instructions.

Construction works along new cable routes, except for tie-ins to existing shafts and transformer stations, shall be carried out in coordination with the NEK and are not subject to specific time restrictions. Work on existing transformer stations and connections to existing manholes may require temporary power supply interruptions to ensure safe execution. The timing of such activities shall be determined by the NEK.

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All erection equipment and tools shall be clearly labelled with information regarding the manufacturer, model, year of manufacture, and other relevant technical data, such as rated power, in accordance with the Law on Safety and Health at Work.

The works shall be executed in full compliance with the approved drawings, technical specifications, calculations, bill of material, and these installation instructions. Any deviation or modification shall be submitted in writing and approved in writing by the NEK's responsible engineer. No changes shall be implemented without an approved FDCR.

The contractor shall prepare a detailed schedule for each work package to prevent overlaps, conflicts, or delays. The schedule shall be reviewed and approved in writing by NEK. In the event of deviations, the schedule shall be updated accordingly during construction.

The contractor shall establish and maintain the construction site in accordance with the Safety Plan and applicable legislation and shall cooperate with the Safety Plan designer in preparing the construction site layout.

Roads designated as fire access routes shall not be blocked. Where excavation works cross a roadway, the work shall be performed in phases to ensure continuous access for fire-fighting vehicles. If this is not feasible, an alternative fire access route shall be provided with the NEK's approval.

The contractor shall, at its own expense, provide and install a construction site information board and secure the construction site with appropriate fencing. The contractor shall also provide all temporary utilities required for construction activities, including power distribution cabinets with protection and metering equipment, and temporary lighting, as needed. Upon completion of the works, all temporary installations and facilities shall be removed, and the construction site shall be restored to its original condition at the contractor's expense.

All equipment, tools, and devices intended for use on the construction site shall be maintained in good working condition and shall be certified and approved by the NEK. Detailed work instructions shall be prepared for each work activity, and the work shall be performed only after their approval.

The investor shall provide the contractor with information regarding known underground installations that are not identified in this DMP for security reasons. The contractor shall verify the location of all existing installations by detection, trial excavation, or other appropriate methods.

All workers and personnel engaged in this modification shall comply with the following regulations:

- Gradbeni zakon – GZ-1
- Zakon o varnosti in zdravju pri delu, Ur. l. RS 43/11
- Uredba o zagotavljanju varnosti in zdravja pri delu na začasnih in premičnih gradbiščih, Ur. l. RS 83/05 in 43/11 – ZVZD-1
- Zakon o varstvu pred požarom, Ur. l. RS 3/07, 9/11, 83/12, 61/17 – GZ, 189/20 – ZFRO in 43/22
- ADP-1.1.033 Varnost in zdravje pri delu v Nuklearni elektrarni Krško. Provide your feedback on BizChat

5. Prerequisites

Requirements before commencement of the works:

- Prepare the installation package in accordance with Procedure ESP-2.619.
- Ensure that all required equipment, tools, materials, and personnel are available for the execution of the installation works.
- Identify, isolate, and de-energize the affected electrical installations, as required, to establish safe conditions within the work area prior to commencement of installation activities.

6. Precautions and restrictions

The Installation Company shall inform the Responsible Engineer (RE) of all discrepancies between actual site conditions and the approved documentation and shall request resolution of the issue. The responsible person shall not continue the work or independently implement a solution without prior approval.

Before commencement of the work, the responsible person shall inform all personnel of the applicable safety regulations and NEK procedures (ADP-1.1.033). All required fences, barriers, and barricades shall be installed to ensure worker safety.

The locations of existing underground electrical installations shall be determined using an approved cable locator. The locations of other underground installations shall be determined by trial excavation. In parallel, a geodetic survey of existing underground installations shall be performed.

Excavation beneath existing electrical installations is not permitted. Protective pipes shall be installed using trenchless drilling methods.

Due to the significant installation depths and the planned shaft depths, all excavations deeper than 1.2 m shall be supported using a slide rail shoring system (SBH 750 for shafts and SBH 790 for trenches, or an approved equivalent).

The responsible person shall implement measures to prevent the entry of foreign materials, debris, or metal chips into equipment, piping systems, or other plant systems.

The responsible person shall ensure that all pipes, cables, and electrical equipment are properly identified, installed, and adequately protected throughout the execution of the works.

The Installation Company shall obtain an approved work order prior to commencing any work activity.

7. Special erection tools and equipment

Standard erection equipment and tools will be used for the purpose of installation works like:

- scaffolding
- steel cutter
- concrete cutter
- diamond coring equipment and diamond core bits
- power tools
- hand tools
- truck crane
- trench excavator
- submersible bilge pump
- slide rail shoring system (type as SBH 750 for shafts and SBH 790 for trench)
- Pit Launched Machine (type as Terra MINI-JET MJLV 1600).

8. Work instructions

8.1. Site Preparation

The contractor shall prepare the site for the execution of the works, considering existing infrastructure, adjacent buildings, and available on-site storage areas.

The contractor shall actively look for existing electrical installations using a cable locator operated in passive mode prior to the commencement of work. The locations of other underground installations shall be verified by test excavations along the proposed routes.

The contractor shall establish a suitable work organization, including the provision of designated areas for temporary storage of construction materials, access for construction machinery, and the delivery of materials and equipment.

The contractor may commence work only after completion of all preparatory activities and receipt of written approval from the supervisory authority.

The contractor shall mark the construction site with an information board and install appropriate fencing. As the project mainly consists of linear infrastructure works, fencing may be installed only around the sections currently under construction.

Safety Measures

The technical solutions adopted during project development have been selected to ensure full compliance with safety requirements and to provide working conditions that do not endanger personnel's lives or health during construction.

During demolition and construction activities, the following safety measures shall be implemented:

- organization and maintenance of the construction site;
- organization of storage areas;
- organization of transportation routes for materials, tools, machinery, equipment, and personnel;
- provision of first-aid facilities;
- inspection and maintenance of tools, machinery, and associated equipment to ensure safe operation;
- proper use of personal protective equipment (PPE), including safety helmets, protective clothing, gloves, safety footwear, and fall-arrest equipment where required;
- environmental restoration of the construction site and reinstatement of the area to its original condition upon completion of the works.

Compliance with safety measures shall be monitored by:

- the contractor;
- the supervising engineer;
- authorized representatives of the relevant regulatory authorities.

Fire Protection Measures During Construction Works

Fire access roads shall not be blocked or closed without the prior concurrence of NEK.

All necessary precautions shall be taken when handling or storing flammable materials. Such materials shall be kept away from ignition sources and heat sources.

Electrical installations, systems, and equipment shall comply with all applicable technical regulations.

Appropriate fire protection measures shall be implemented in all areas where a fire hazard exists. Flammable liquids (gasoline, diesel fuel, oils, etc.) shall be stored in designated fire-protected storage areas in accordance with applicable regulations.

The contractor shall be responsible for implementing all fire protection measures.

Compliance with fire protection measures shall be monitored by:

- the contractor;
- the supervising engineer;
- authorized representatives of the relevant regulatory authorities.

Environmental Protection Measures

During construction activities, conditions shall be maintained to ensure the uninterrupted flow of traffic, particularly on roads and routes required for access by emergency and fire-fighting vehicles.

The discharge of wastewater, fuels, lubricants, or other pollutants into the ground is prohibited. Unauthorized disposal of waste is also prohibited.

Bulk construction materials shall be transported in technically suitable vehicles. Where necessary, loads shall be covered or moistened to prevent dust generation, particularly during windy conditions.

Wastewater generated during construction shall be collected and managed using impermeable drainage systems. Construction materials, fuels, lubricants, paints, and other chemicals shall be stored and handled in accordance with applicable regulations. Hazardous substances shall be stored on impervious surfaces designed to prevent contamination of soil and groundwater.

Areas designated for refueling and servicing construction equipment shall be protected by containment systems constructed of chemically resistant impermeable materials capable of collecting accidental spills and directing them to an oil-water separator. Existing paved areas connected to an oil separator may also be used for this purpose. Refueling and servicing areas shall be covered and located on impermeable surfaces that can be cleaned using dry cleaning methods.

Uncontrolled disposal of construction materials, as well as any activity that may adversely affect the environment or hinder future maintenance activities, is prohibited. Dust generation shall be minimized during construction works and, where necessary, controlled by water spraying.

Topsoil (humus) removed during excavation shall be stockpiled within the construction area and reused during final landscaping and restoration of disturbed areas. Excavated material suitable for reuse shall be retained and utilized for reinstatement works where applicable.

8.2. Geodetic Works

Geodetic works shall include staking out of all relevant structural elements by transferring design coordinates and elevations to the field, the maintenance and renewal of setting-out points during construction, and the surveying and monitoring of all works throughout construction until final handover to the Investor.

The Contractor shall continuously verify and maintain the accuracy of all setting-out axes, benchmarks, and reference points during construction.

8.3. TP1 - Civil Works

On the western exterior wall, six penetrations for DN 110 pipes shall be prepared, arranged in two horizontal rows of three pipes each. The exact pipe locations are specified in the project drawings. The penetrations shall be executed using a Ø120–125 mm core drill, providing sufficient annular clearance for proper pipe installation and application of a watertight sealing system. The annular space between the pipe and the concrete wall shall be sealed using a watertight sealing compound (e.g., waterproof mortar or another approved equivalent sealant).

Before commencing any drilling activities, the contractor shall consult the Site Project Manager to confirm the final penetration diameters, verify the pipe locations, and obtain approval for the proposed sealing method and materials.

8.4. TP3 - Civil Works

On the western exterior wall, six penetrations for DN 110 pipes shall be prepared, arranged in two horizontal rows of three pipes each. The exact pipe locations are specified in the project drawings. The penetrations shall be executed using a Ø120–125 mm core drill, providing adequate annular clearance for proper pipe installation and application of a watertight sealing system in accordance with standard drilling practices. The annular gap between the concrete wall and the pipe shall be sealed with a watertight sealing compound (e.g., waterproof mortar or an approved equivalent sealant).

Before commencing any drilling activities, the contractor shall consult the Site Project Manager to confirm the final penetration diameters, verify the pipe locations, and obtain approval for the sealing method and materials to be used.

8.5. MHE 04 & MHE 05 - Civil Works

In MHE04, on the northern wall, and in MHE05, on the eastern wall, six penetrations for DN 110 pipes shall be prepared, arranged in two horizontal rows of three pipes each. The exact pipe locations are specified in the project drawings.

The penetrations shall be executed using a Ø120–125 mm core drill, providing adequate annular clearance for proper pipe installation and application of a watertight sealing system in accordance with standard drilling practices. The annular gap between the concrete wall and the pipe shall be sealed with a watertight sealing compound (e.g., waterproof mortar or an approved equivalent sealant).

Before commencing any drilling activities, the contractor shall consult the Site Project Manager to confirm the final penetration diameters, verify the pipe locations, and obtain approval for the sealing method and materials to be used.

8.6. Underground Cable Ducts Infrastructure - Civil Works

Construction works associated with the installation of the cable duct system mainly consist of geodetic surveying during excavation and installation activities, trench excavation, placement and compaction of bedding and backfill materials, backfilling, and final restoration of the existing terrain.

Prior to the construction of any duct or shaft, the excavation shall be inspected and approved by a geotechnical engineer.

The proposed route runs predominantly parallel to existing cable duct routes.

The ducts shall be installed at the depths specified in the longitudinal section drawings for each route section. The bottom of the cable duct system shall be located at depths ranging from 1.6 m to 3.7 m.

The layout of the proposed ducts is shown on Drawing E-303-100A. The planned duct route crosses the existing installations listed in Table 1. The layout also takes into account installations associated with projects currently under development or construction. Crossings with both existing and proposed installations are identified and numbered in the longitudinal section drawings.

The trench cross-section for the cable duct is shown in DWG B-436-026-0.

New electrical installation	Existing installations crossing
Number	
1	Sewer pipe elevation 153,32 m (top of pipe). New cable duct passes above the pipe.
2	Toplovod, elevation 154,36 m (top of pipe). New cable duct passes below the pipe.
2.1	Technical safety installation-duct, elevation 152.76 m (top of duct). New cable duct passes above the duct.
3	Electrical installation LV, elevation 154,84 m (top of duct). New cable duct passes below the duct.
4	Potable water pipe, elevation 154,73 (top of pipe). New cable duct passes below the pipe.
5	Electrical installation LV, elevation 154,84 m (top of duct). New cable duct passes below the duct.
6	Electrical installation LV-duct, elevation 154,84 m (top of duct). New cable duct passes below the duct.
7	Sewer pipe elevation 153,65 m (top of pipe). New cable duct passes below the pipe.
8	Telecommunications installation, elevation 153,95 (top). New cable duct passes below the duct.
9	Fire protection installation (Požarno javljanje), elevation 153,95. New cable duct passes below the duct.

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10	Data communication installation, elevation 153,95 (top of duct). New cable duct passes below the duct.
11	Electrical installation LV, elevation 153,98 m (top of duct). New cable duct passes below the duct.
12	Electrical installation LV, elevation 153,98 m (top of duct). New cable duct passes below the duct.
13	Electrical installation LV, elevation 153,98 m (top of duct). New cable duct passes below the duct.
14	Cable duct, elevation 154,18 (top of duct). New cable duct passes above the duct.
15	Potable water pipe, elevation 154,52 (top of pipe). New cable duct passes below the pipe.
16	Electrical installation LV, elevation 154,78 m (top of duct). New cable duct passes below the duct.
17	Electrical installation LV, elevation 154,48 m (top of duct). New cable duct passes below the duct.
18	Electrical installation LV, elevation 154,48 m (top of duct). New cable duct passes below the duct.
19	Potable water pipe, elevation 154,64 (top of pipe). New cable duct passes below the pipe.
20	Hydrant pipe, elevation 152,99 (top of pipe). New cable duct passes below the pipe.
21	Electrical installation, elevation 154,18 m (top of duct). New cable duct passes below the duct.
22	Hot water pipeline (Toplovod), elevation 154,54 m (top of pipe). New cable duct passes below the pipe.
23	Hot water pipeline (Toplovod), elevation 154,54 m (top of pipe). New cable duct passes below the pipe.
24	Storm water sewer elevation 153,71 (bottom of pipe). New cable duct passes below the pipe.
25	High voltage cable-not used, elevation unknown.
25.1	Technical safety installation-duct, elevation 154.23 m (top of duct). New cable duct passes below the duct.
26	Other installation (Trasa Ž prečkanja), elevation 154,97 m (top of duct). New cable duct passes below the duct.
27	Other installation (Trasa Ž prečkanja), elevation 154,97 m (top of duct). New cable duct passes below the duct.
28	Other installation (Trasa Ž prečkanja), elevation 154,96 m (top of duct). New cable duct passes below the duct.
29	Other installation (Trasa Ž prečkanja), elevation 154,91 m (top of duct). New cable duct passes below the duct.
30	Electrical installation LV, elevation 154,18 m (top of duct). New cable duct passes below the duct.
31	Storm water sewerage elevation 154.65 (bottom of pipe). New cable duct passes below the pipe.
32	Storm water sewer elevation 154.92 (bottom of pipe). New cable duct passes pipe.

33	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
34	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
35	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
36	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
37	Gas pipe, elevation 154,78 (top of duct). New cable duct passes below the pipe.
38	Other installation (Trasa Ž prečkanja), elevation 154,78 m (top of duct). New cable duct passes below the duct.
39	Other installation (Trasa Ž prečkanja), elevation 154,78 m (top of duct). New cable duct passes below the duct.
40	Other installation (Trasa Ž prečkanja), elevation 154,78 m (top of duct). New cable duct passes below the duct.
41	Cable duct, elevation 153,85 (top of duct). New cable duct passes below the duct.
42	Other installation (Trasa Ž prečkanja), elevation 154,80 m (top of duct). New cable duct passes below the duct.
43	Other installation (Trasa Ž prečkanja), elevation 154,59 m (top of duct). New cable duct passes below the duct.
44	Other installation (Trasa Ž prečkanja), elevation 154,63 m (top of duct). New cable duct passes below the duct.
45	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
46	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
47	Potable water pipe- not used, elevation unknown.
48	Potable water pipe, elevation 154,02 (CL of pipe). New cable duct passes below the pipe.
49	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
50	Well water pipe, elevation 154,67 (top of pipe). New cable duct passes below the pipe.
51	Process water pipe, elevation 154,28 (CL of pipe). New cable duct passes below the pipe.
52	Well water pipe, elevation 154,50 (top of pipe). New cable duct passes below the pipe.
53	Storm water sewer elevation 154.34 (top of pipe). New cable duct passes below the pipe.
54	Storm water sewer elevation 152.85 (bottom of pipe). New cable duct passes below the pipe.
55	Process water pipe, elevation 154,50 (top of pipe). New cable duct passes below the pipe.

Table 1: List of existing installations crossings

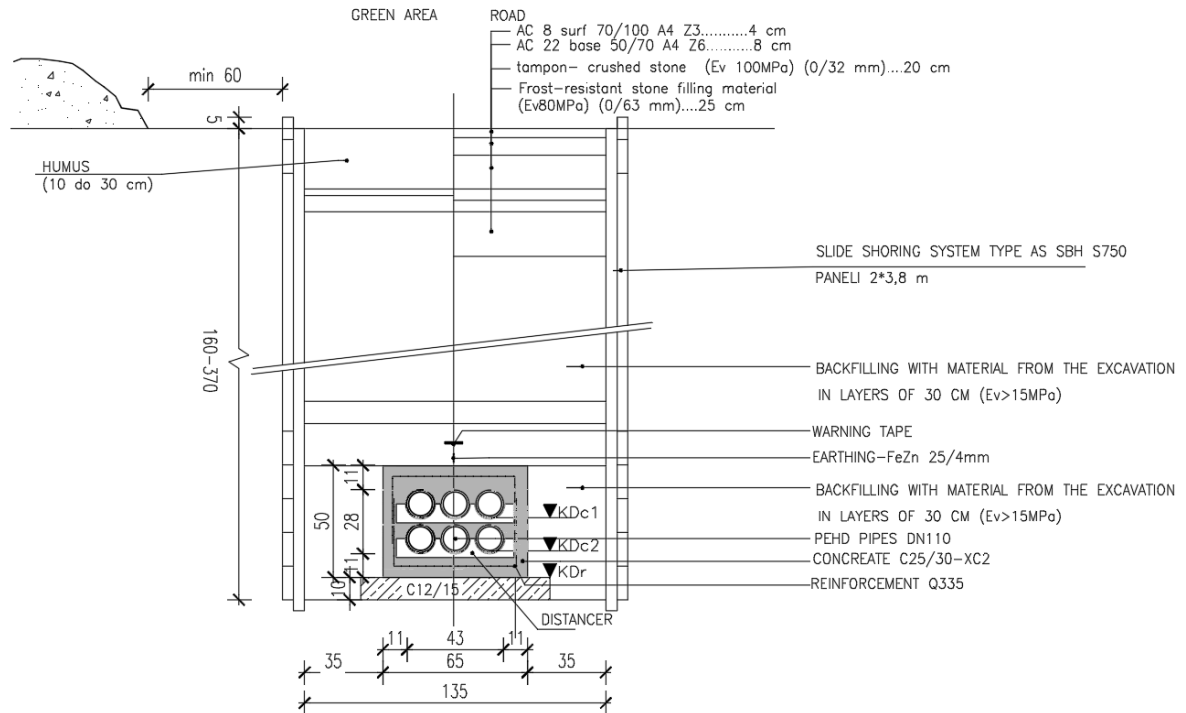


Figure 1: Normal trench cross-section

Due to the large number of existing installations located in the immediate vicinity of the proposed routes and the significant installation depth of the duct system, excavation shall be carried out using a shoring system certified for excavation depths of up to 4 m and trench widths of up to 1.5 m (SBH 790 type or approved equivalent).

The trench width for the cable duct installation shall be 135 cm in accordance with DIN 4124. The cables shall be installed within six PEHD ducts arranged in a 3×2 configuration.

The trench bottom shall be prepared over the full width and length of the pipeline with the specified gradient and a maximum deviation of ± 3 cm. The minimum required soil compaction shall be $M_s = 15 \text{ MN/m}^2$. Trench bottom preparation for cable ducts shall be identical to that for pipelines, except where pit-launched drilling is used.

The cable duct trench shall be provided with a 100 mm thick C10/15 concrete bedding layer.

The trench width shall be sufficient to allow electrofusion welding, alignment of the pipes along the trench bottom, and proper placement and compaction of side backfill material.

Care shall be taken to prevent moisture accumulation in the excavated soil during trench preparation and pipe installation activities.

Uniform pipe support and proper alignment require a trench bottom consisting of stable soil free of protruding rocks, stones, or soil clumps. Very soft soils, such as muck or similar unsuitable materials, do not provide adequate support and shall be removed and replaced with suitable granular material.

During pipe installation and jointing, pipe ends shall be kept free of mud and other foreign materials. Proper fit-up and alignment shall be maintained at all times.

Whenever pipe assembly activities are interrupted, temporary end caps or closures shall be installed to prevent the ingress of foreign material.

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Dry trench conditions are a prerequisite for proper pipe installation and concrete placement.

PEHD ducts (DN110, SDR 26) shall be installed within a 65×50 cm concrete (C25/30) encasement block (3×2 duct arrangement) and maintained in the required position using spacers.

The duct system shall run continuously from shaft to shaft or between a shaft and a building. On one side of each shaft or building wall, the concrete duct encasement shall terminate 1 m before the structure, where an expansion joint shall be provided. The expansion joint detail is shown on the applicable drawing.

At the expansion joint location, the ducts shall be installed on a 20 cm sand bedding layer and covered with sand to a depth of 20 cm above the ducts. The remainder of the trench shall be backfilled in the same manner as the adjacent trench sections. To prevent mixing of materials, the sand bedding and surround shall be wrapped in geotextile. Prior to entering the shaft or building wall, the ducts shall be connected using an approved expansion coupling.

Upon completion of duct installation for each route section and prior to concrete placement, each duct shall be inspected with a CCTV camera to verify continuity and passability.

Following successful testing and inspection, the ducts shall be backfilled with excavated material in layers approximately 30 cm thick. The minimum required compaction shall be $M_s = 15 \text{ MN/m}^2$. Backfill material shall be placed uniformly on both sides of the duct system.

A polyethylene warning tape shall be installed 150 mm above the top of the concrete encasement block.

In traffic areas, trench backfill shall be executed in two layers using mechanically crushed stone. The first layer shall consist of frost-resistant material 0/63 mm, compacted to $M_s = 80 \text{ MN/m}^2$. The second layer shall consist of crushed stone 0/32 mm compacted to $M_s = 100 \text{ MN/m}^2$. The required compaction characteristics shall be achieved using suitable compaction equipment in accordance with the Guidelines and Technical Conditions for Construction of Asphalt Layers. For green areas, the minimum required compaction shall be $M_s = 15 \text{ MN/m}^2$.

The final pavement restoration shall consist of a concrete base layer C16/20 and a 10 cm asphalt layer matching the characteristics of the existing pavement.

During trench excavation and cable duct installation activities, special attention shall be paid to preventing trench collapse and the falling of excavated material. For excavations deeper than 1.25 m, approved trench shoring systems shall be installed, and all necessary measures shall be implemented to ensure the safety of personnel and equipment.

Sections of the excavation route passing through green areas or pedestrian paths shall be covered with suitable steel plates or equivalent protective coverings. The excavation area shall be secured with protective fencing, and pedestrian access shall be maintained at all times.

In paved or asphalt areas, excavated material shall be loaded directly into transport vehicles and removed to an approved disposal location designated for that type of material.

Excavation works shall be carried out with additional caution in the vicinity of existing underground installations to prevent damage.

The locations of existing installations are shown on the layout drawings, while their elevations are shown on the longitudinal section drawings (E-303-100A and D-436-011).

The actual elevations of existing installations shall be verified on site by trial excavation prior to commencement of the works. Existing electrical installations shall additionally be located using a cable detector operating in passive mode. All excavation works in the vicinity of existing installations shall be carried out manually to prevent damage.

8.7. Pit Launched Drilling

When a new duct route crosses a road or an existing installation and the proposed duct alignment passes beneath the existing installation, the duct shall be installed using a trenchless method, such as pit-launched drilling (e.g., Terra MINI-JET MJLV 1600 or an approved equivalent), rather than open-cut trench excavation.

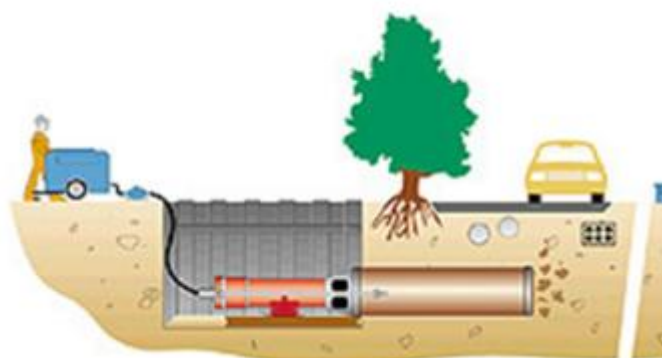


Figure 2: Pit launched drilling

This method eliminates the risk of long-term settlement, deformation, damage, or disruption of existing installations.

For pit-launched drilling, a launch pit and a reception pit shall be constructed. Due to the excavation depth (up to 4 m), both pits shall be secured using an approved shoring system to ensure safe working conditions.

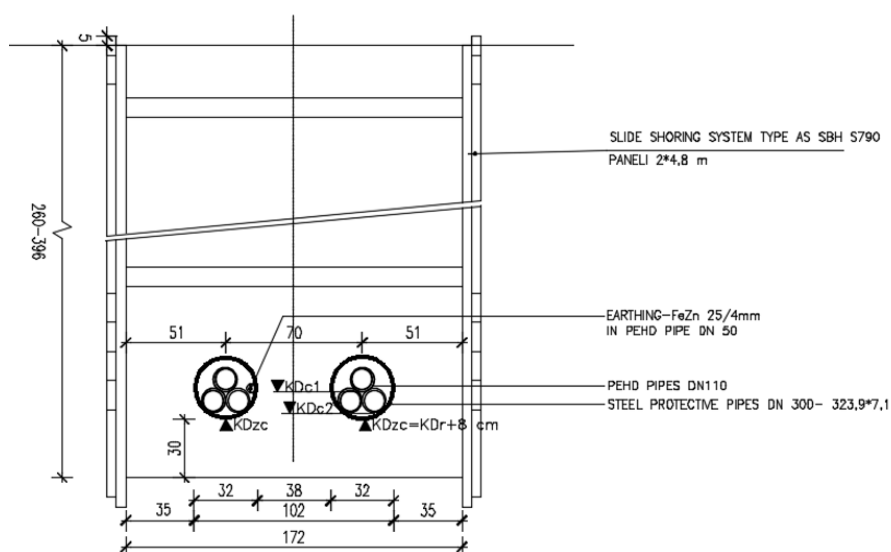


Figure 3: Launching pit cross-section

The exact dimensions of the launch and reception pits shall be determined based on the requirements of the selected drilling system. The working area within each pit shall be

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approximately 130 cm wide and 2.5 m long. The pit depth shall extend approximately 30 cm below the centerline of the lowest duct in the proposed duct bank.

The trenchless installation shall be performed by jacking two steel casing pipes, $\text{Ø}323.9 \times 7.1$ mm, through the soil, after which the 2x3 arrangement of PEHD DN110 ducts shall be installed within the casing pipes.

The steel casing pipes may be installed with a horizontal center-to-center spacing of 70 cm. The permissible alignment deviation shall not exceed ± 3 cm per meter of drilled length.

Drilling lengths are indicated in the longitudinal section drawings.



Figure 4: Pit launch machine

8.8. New Shafts - JE156, JE157, JE158, JE159, JE160, JE161 - Civil Works

JE156 is a reinforced concrete shaft located in a green area. The external dimensions of the shaft are 2.0×2.0 m. The shaft depth is 3.20 m, while the total depth, including the sump, is 3.60 m. A B125 cover, 800×800 mm, is provided in the top slab.

JE157 is a reinforced concrete shaft located partly within a roadway and partly within a green area. The external dimensions of the shaft are 2.5×2.5 m. The shaft depth is 4.29 m, while the total depth, including the sump, is 4.69 m. A C250 cover, 800×800 mm, is provided in the top slab.

JE158 is a reinforced concrete shaft located in a green area. The external dimensions of the shaft are 2.0×2.0 m. The shaft depth is 4.44 m, while the total depth, including the sump, is 4.84 m. A B125 cover, 800×800 mm, is provided in the top slab.

JE159 is a reinforced concrete shaft located in a green area. The external dimensions of the shaft are 2.0×2.0 m. The shaft depth is 4.41 m, while the total depth, including the sump, is 4.81 m. A B125 cover, 800×800 mm, is provided in the top slab.

JE160 is a reinforced concrete shaft located in a green area. The external dimensions of the shaft are 2.5×2.5 m. The shaft depth is 3.87 m, while the total depth, including the sump, is 4.27 m. A B125 cover, 800×800 mm, is provided in the top slab.

JE161 is a reinforced concrete shaft located in a green area. The external dimensions of the shaft are 2.5×2.5 m. The shaft depth is 3.80 m, while the total depth, including the sump, is 4.20 m. A B125 cover, 800×800 mm, is provided in the top slab.

All shafts shall be equipped with metal access ladders (FABA ladder safety system with portable access rail, or approved equivalent). A 500 × 500 × 400 mm sump shall be provided at the bottom of each shaft and connected to a PEHD DN110 drainage pipe. The shaft base slab shall be constructed with a 1% slope towards the sump. The thickness of all shaft walls and slabs shall be 300 mm.

A drainage layer consisting of 8/16 mm washed gravel wrapped in geotextile shall be provided beneath each shaft. The remaining excavation below the the base slab shall be filled with gravel and provided with a 100 mm thick C12/15 concrete blinding layer. Backfilling around the shafts shall be carried out in 300 mm layers using excavated material.

Prior to the construction of the shafts, a slide rail shoring system (SBH S750 type or approved equivalent) shall be installed to ensure safe working conditions. The minimum clearance between the shoring system and the exterior wall of the shaft shall be 500 mm.

8.9. Excavation Works

Excavation of shafts and cable ducts shall be carried out in accordance with the approved project documentation.

Prior to the commencement of construction activities, the excavation shall be inspected by the responsible geotechnical engineer. If the ground conditions are acceptable, the geotechnical engineer shall approve the continuation of the works by making an entry in the construction logbook.

If the contractor encounters any unknown structures, utilities, installations, or other objects during excavation, the work shall be stopped immediately, and the NEK, as well as the supervising engineer, shall be informed.

Excavation shall be carried out in accordance with the design drawings, either manually or mechanically, to the required depth. The excavation shall include leveling the bottom of the excavation, supporting vertical trench or pit walls using the approved slide rail shoring system, and dewatering, where necessary.

Trenches and excavation pits up to 1.25 m deep may be excavated without shoring or formwork, provided soil conditions permit safe excavation in accordance with applicable regulations.

During earthworks, the following shall be monitored and controlled:

- whether the excavation is performed in accordance with the positions and elevations specified in the design drawings;
- whether excavation activities adversely affect or damage adjacent structures, installations, or surrounding soil;
- that no unnecessary over-excavation is carried out;
- that the foundation soil is not damaged due to improper excavation methods;
- that adequate drainage is provided throughout the excavation period and until completion of the structure;
- that water accumulation within excavations is prevented.

Where excavation is performed in the vicinity of gas, electrical, water, or other utility installations, the work shall be carried out under the direction and supervision of qualified personnel. If any unidentified utility or installation is uncovered during excavation, work shall be suspended until appropriate supervision is provided.

Installations that remain in service during construction shall be adequately protected against damage. The Contractor shall notify the supervising engineer of all identified installation locations. All applicable regulations governing the protection and operation of existing installations shall be considered.

Where required, unsuitable soil shall be replaced with 8–16 mm stone material (natural gravel or crushed aggregate free of organic matter) to achieve the required bearing capacity, compaction, or drainage characteristics.

Compaction shall be performed in layers not exceeding 300 mm using a vibratory compactor or equivalent equipment. Upon completion of the works, the site shall be graded and all surplus material removed from the construction area.

Excavation shall be performed in stages, with the installation and lowering of the selected slide rail shoring system carried out progressively as excavation advances.

The shoring system shall consist of:

- a) Installation of steel posts into the ground;
- b) Progressive excavation in stages, accompanied by the installation and positioning of shoring panels;
- c) Stabilization of the top of the steel posts using horizontal steel struts or beams.

8.10. Scaffolding And Formwork

Scaffolding and formwork shall be designed, erected, and maintained to safely withstand all loads and impacts arising during construction without excessive settlement or deformation, while ensuring the dimensional tolerances specified in the structural design.

The formwork shall be constructed in such a manner that no loss of cement paste or other concrete constituents occurs during concrete placement.

Where formwork ties or fixing elements pass through the concrete, they shall not adversely affect the concrete structure or its durability. The formwork shall be designed and installed to allow safe, easy removal without damaging the completed concrete structure.

The internal surfaces of the formwork shall be clean and, where required, treated with an appropriate release agent.

The formwork shall be removed progressively, without impact, vibration, or shock loading, only after the concrete has attained the following minimum compressive strength:

- **30% of the specified concrete strength for wall formwork removal (for concrete class C30/37: 11 N/mm²).**
- **70% of the specified concrete strength for slab formwork removal (for concrete class C30/37: 26 N/mm²).**

8.11. Concrete Structures

Execution Of Concrete Works- Summary

On prepared ground, a 10 cm thick lean concrete blinding layer shall be installed, followed by the construction of the foundation footing using concrete C30/37, XC4/XF3, CI 0.20, $D_{\max}$ 16 mm. The concrete shall be manufactured, supplied, placed, compacted, and cured in accordance with SIST EN 206, SIST 1026, SIST EN 13670, and the applicable National Annexes.

Reinforcement steel grade B500B shall be installed in accordance with SIST EN 10080 and SIST EN 1992-1-1. A minimum of 30% of the reinforcement shall be welded and connected to the earthing system, as specified in the electrical section of the DMP.

Concrete acc. to SIST EN 206, SIST 1026, SIST EN 1992-1-1 shall be used:

- construction concrete: C30/37 ; XC4, XD1, XF3; CI 0,2; $D_{\max}$ =32 mm
- concrete cover: min 4 cm (outside)
- concrete cover: min 3 cm (inside)
- lean concrete C12/15; X0
- execution class 2, tolerance class 1 acc. to SIST EN 13670 and national annex

	Exposure classes																	
	No risk of corrosion or attack	Carbonation-induced corrosion				Chloride-induced corrosion						Freeze/thaw attack				Aggressive chemical environments		
						Sea water			Chloride other than from sea water									
		X0	XC 1	XC 2	XC 3	XC 4	XS 1	XS 2	XS 3	XD 1	XD 2	XD 3	XF 1	XF 2	XF 3	XF 4	XA 1	XA 2
Maximum w/c^a	–	0,65	0,60	0,55	0,50	0,50	0,45	0,45	0,55	0,55	0,45	0,55	0,55	0,50	0,45	0,55	0,50	0,45
Minimum strength class	C12/15	C20/25	C25/30	C30/37	C30/37	C30/37	C35/45	C35/45	C30/37	C30/37	C35/45	C30/37	C25/30	C30/37	C30/37	C30/37	C30/37	C35/45
Minimum cement content ^c (kg/m³)	–	260	280	280	300	300	320	340	300	300	320	300	300	320	340	300	320	360
Minimum air content (%)	–	–	–	–	–	–	–	–	–	–	–	–	4,0 ^a	4,0 ^a	4,0 ^a	–	–	–
Other requirements	–	–	–	–	–	–	–	–	–	–	–	Aggregate in accordance with EN 12620 with sufficient freeze/thaw resistance				–	Sulfate-resisting cement ^b	

^a Where the concrete is not air entrained, the performance of concrete should be tested according to an appropriate test method in comparison with a concrete for which freeze/thaw resistance for the relevant exposure class is proven.

^b Where sulfate in the environment leads to exposure classes XA2 and XA3, it is essential to use sulfate-resisting cement conforming to EN 197-1 or complementary national standards.

^c Where the *k*-value concept is applied the maximum w/c ratio and the minimum cement content are modified in accordance with 5.2.5.2.

Table 2: Recommended limiting values for composition and properties of concrete

Reinforcement B500B acc. to SIST EN 10080, SIST EN 1992-1-1

Concrete surface finish type shall be acc. to SIST EN 13670 and national annex

Formed surfaces:

- visible surfaces: simple
- invisible surface: basic

Unformed structures:

- visible surfaces: simple
- invisible surface: basic

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Cast iron covers shall be installed acc. to the manufacturer's details

At least 30% of the reinforcement shall be welded and electrically bonded to the earthing system. For earthing details, refer to the electrical section of the DMP.

The ground beneath the foundation slab shall be compacted to achieve a minimum dynamic deformation modulus of $E_{vd} \geq 50$ MPa.

All dimensions shall be verified on site prior to construction and adjusted as necessary to suit actual site conditions.

General Recommendations

The works shall be carried out in accordance with EN 13670 and all other applicable regulations and legislation. For each type of concrete structure, the manufacturer or contractor shall submit the relevant documentation demonstrating compliance.

Concrete placement shall commence only after the formwork and reinforcement have been completely installed and inspected.

The reinforcement shall remain in its correct position during concrete placement and shall be fully embedded in concrete over the entire length and circumference of the reinforcing bars.

Each structural element shall be concreted continuously wherever possible. Adding water to fresh concrete is not permitted. In the event of inadequate workability, the use of a superplasticizer in accordance with EN 934 is permitted. If an interruption in concreting is unavoidable, the resulting construction joint shall be structurally acceptable and approved by the responsible engineer.

Fresh concrete shall be placed using suitable equipment in layers not exceeding 500 mm in thickness. Each newly placed layer shall be adequately bonded to the preceding layer. If concreting is interrupted, the surface of the previously placed concrete shall be properly prepared and cleaned before placement is resumed.

Reinforcement and embedded items shall be fully enclosed in concrete and provided with the specified concrete cover within the allowable tolerances to ensure the required structural strength and durability. Particular attention shall be given to the placement and compaction of concrete at changes in section, narrow sections, openings, and areas with congested reinforcement.

During placement and compaction, the concrete shall be protected from direct sunlight, strong winds, freezing rain, snow, and excessive water exposure.

For concrete supplied from a concrete plant, the supervising engineer shall define the inspection and testing requirements necessary to verify the properties of fresh concrete and the compressive strength of hardened concrete on site.

Concrete shall be placed in accordance with the structural design documentation, EN 13670, the standards referenced therein, and the applicable Technical Regulation for Concrete Structures.

If concrete placement is interrupted due to unforeseen circumstances, appropriate measures shall be taken to ensure that the interruption does not adversely affect the load-

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bearing capacity or other performance characteristics of the structure. If the interruption is not executed in accordance with the design requirements, the contractor shall prepare the concrete surface at the construction joint and, if necessary, remove unsatisfactory concrete to provide a suitable substrate for the continuation of concrete placement.

The temperature of fresh concrete at the time of placement shall not be lower than +5 °C. Unless special concreting procedures are specified, the temperature of fresh concrete at placement shall not exceed +30 °C.

Concrete shall be transported and placed in the formwork in a manner that prevents segregation and preserves the specified properties of the concrete.

The concrete shall have a consistency suitable for achieving the required density and compaction by mechanical means. The subsequent addition of water to fresh concrete is not permitted.

The free-fall height of concrete shall not exceed 1.5 m, unless appropriate measures are implemented to prevent segregation.

Concrete shall be placed in layers not exceeding 500 mm in thickness. Each subsequent layer shall be placed within a time interval that ensures proper bonding with the previously placed layer. When concrete is placed in multiple layers, compaction shall be carried out so that the upper layer is vibrated and the underlying layer is re-vibrated to ensure monolithic behavior.

For concrete of compressive strength class C25/30 and higher, concrete produced in an approved concrete plant, whether located on site or off site, shall be used. The concrete shall be transported to the construction site and subsequently delivered to the point of placement using suitable equipment.

Control procedures at the construction site

FRESH CONCRETE

For concrete supplied from a concrete plant, the person responsible shall establish inspection and testing procedures to verify the properties of fresh concrete prior to placement. Testing shall be performed on samples taken immediately before concrete placement in the structure, in accordance with EN 13670, EN 206, and the project requirements.

The inspection shall include, as a minimum, verification of the delivery documentation for each concrete delivery and visual assessment of concrete consistency. Where justified by observations or concerns regarding concrete quality, the consistency shall be tested using the same method applied during production control.

Production	Minimum rate of sampling		
	First 50 m ³ of production	Subsequent to first 50 m ³ of production ^a , the highest rate given by:	
		Concrete with production control certification	Concrete without production control certification
Initial (until at least 35 test results are obtained)	3 samples	1 per 200 m ³ or 1 per 3 production days ^d	1 per 150 m ³ or 1 per production day ^d
Continuous ^b (when at least 35 test results are available)	---	1 per 400 m ³ or 1 per 5 production days ^{c, d} or 1 per calendar month	

^a Sampling shall be distributed throughout the production and should not be more than 1 sample within each 25 m³.

^b Where the standard deviation of the last 15 or more test results exceeds the upper limits for s_n according to Table 19, the sampling rate shall be increased to that required for initial production for the next 35 test results.

^c Or if there are more than 5 production days within 7 consecutive calendar days, once per calendar week.

^d The definition of a 'production day' shall be stated in provisions valid in the place of use.

Table 3: Minimum rate of sampling for assessing conformity

According to EN 206 and the table above, the minimum scope of testing shall be as follows:

- 3 samples shall be taken from the **first batch** for concreting the base slabs of the electrical shafts.
- 3 samples shall be taken from the **second batch** for concreting the walls of the electrical shafts.

HARDENED CONCRETE

For concrete supplied from a concrete plant, the person responsible shall establish inspection and testing procedures to verify the hardened concrete's properties.

Compressive strength shall be determined on 150 mm concrete cube specimens in accordance with EN 12390-1 and EN 12390-2.

One test sample shall be taken for structural elements concreted continuously within a 24-hour period, provided that the concrete is of the same specified class and supplied by the same manufacturer.

Curing class

Concrete curing and protection measures shall comply with the requirements of EN 13670, Annex F, Section F.8.5.

Curing classes are defined by the curing period or the percentage of specific characteristic 28-day compressive strength according to Table 4.

	Curing class 1	Curing class 2	Curing class 3	Curing class 4
Period (hours)	12 ^a	NA	NA	NA
Percentage of specified characteristic 28 days compressive strength	Not applicable (NA)	35 %	50 %	70 %
^a Provided the set does not exceed 5 hours, and the surface concrete temperature is equal to or above 5 °C				

Table 4: Curing classes

Surface concrete temperature (t), °C	Minimum curing period, days ^a		
	Concrete strength development ^{c, d}		
	$(f_{cm2}/f_{cm28}) = r$		
	rapid $r \geq 0,50$	medium $0,50 > r \geq 0,30$	slow $0,30 > r \geq 0,15$
$t \geq 25$	1,5	2,5	3,5
$25 > t \geq 15$	2,0	4	7
$15 > t \geq 10$	2,5	7	12
$10 > t \geq 5$ ^b	3,5	9	18
^a Plus any period of set exceeding 5 h.			
^b For temperatures below 5 °C, the duration should be extended for a period equal to the time below 5 °C.			
^c The concrete strength development is the ratio of the mean compressive strength after 2 days to the mean compressive strength after 28 days determined from initial tests or based on known performance of concrete of comparable composition (see EN 206-1).			
^d For very slow concrete strength development, special requirements should be given in the execution specification.			

Table 5: Minimum curing period for curing class 3 (corresponding to a surface concrete strength equal to 50% of the specified characteristic strength)

Geometrical tolerances

Geometrical tolerances for foundations and walls shall comply with EN 13670, Annex G.

Type of structure	Material of the structure	Means of transport	Class
Foundation	concrete	the pump, bucket on the crane	S4

Table 6: Consistency Class of Fresh Concrete (Slump)

Class	Slump tested in accordance with EN 12350-2 mm
S1	10 to 40
S2	50 to 90
S3	100 to 150
S4	160 to 210
S5 ^a	≥ 220

Table 7: Slum classes

Compressive strength

Type of structure	Compressive strength
Foundation slab and walls	C30/37

Table 8: Compressive strength class

Chloride content

Chloride content in concrete must not exceed the values defined in the Table 9 (according to **EN 206-1: 2006**)

Type of concrete structure	class	the highest content of chloride by weight of cement
Reinforced concrete	CI 0,20	0,20 %

Table 9: Chloride content in concrete

8.12. Reinforcement Steel Works

All reinforcement steel bending and installation works shall be carried out in accordance with the applicable standards, regulations, and project requirements.

Upon delivery of reinforcement steel, the supplier shall provide a valid Declaration of Performance (DoP). Each item shall be clearly marked and identifiable in accordance with EN 10027. Reinforcement shall be sorted and stored by type and diameter at the construction site.

The surface of reinforcement shall be free from loose rust, oil, grease, dirt, paint, or any other substances that may adversely affect the steel, the concrete, or the bond between them.

Steel bars and welded mesh shall be cut and bent in accordance with the project drawings and specifications. The following requirements shall apply:

- Bending shall be performed at a uniform speed.
- Bending at temperatures below 5°C shall only be carried out with appropriate special precautions.
- Hot bending or bending with heating shall only be permitted with prior approval from the Engineer.

Steel bars, welded mesh, and prefabricated reinforcement cages shall be protected from damage during transportation, storage, handling, and installation.

Prior to placing reinforcement, all bars shall be cleaned of dirt, grease, loose rust, and any contaminants. Reinforcement placed directly on the ground shall be supported on a previously prepared lean concrete layer.

Suitable spacers and supports shall be used to maintain the required concrete cover and spacing between reinforcement and formwork. Before the installation of reinforcement, all required inspection and supervision activities specified in SIST EN 13670 shall be carried out.

Reinforcement spacing, arrangement, and concrete cover thickness shall comply with the approved design documentation. Where a specified bar diameter is unavailable, substitution shall only be permitted with the approval of the Structural Engineer.

Concrete placement shall not commence until the reinforcement has been thoroughly inspected and approved by the Supervising Engineer.

Reinforcement steel shall consist of weldable reinforcing steel conforming to EN 10080.

Welding of reinforcement shall be performed in accordance with EN ISO 17660. Flash-butt welding may be used where required and approved.

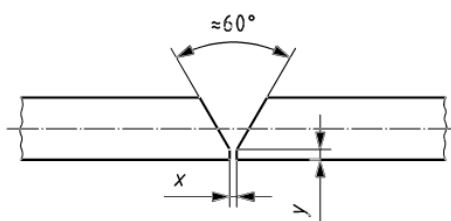


Figure 5: Welding detail

Description	Material	Characteristic tensile strength
Steel bars	B500B	$f_{yk} = 500 \text{ MPa}$

Table 10: Steel bars (SIST EN 10027-1, SIST EN 10027-2)

8.13. Watertight Sealing

Watertight sealing of pipe penetrations through reinforced concrete walls shall be provided using a swelling waterstop system equivalent to SikaSwell® S-2 and SikaSwell® Profile (or approved equal), installed strictly in accordance with the manufacturer's instructions.

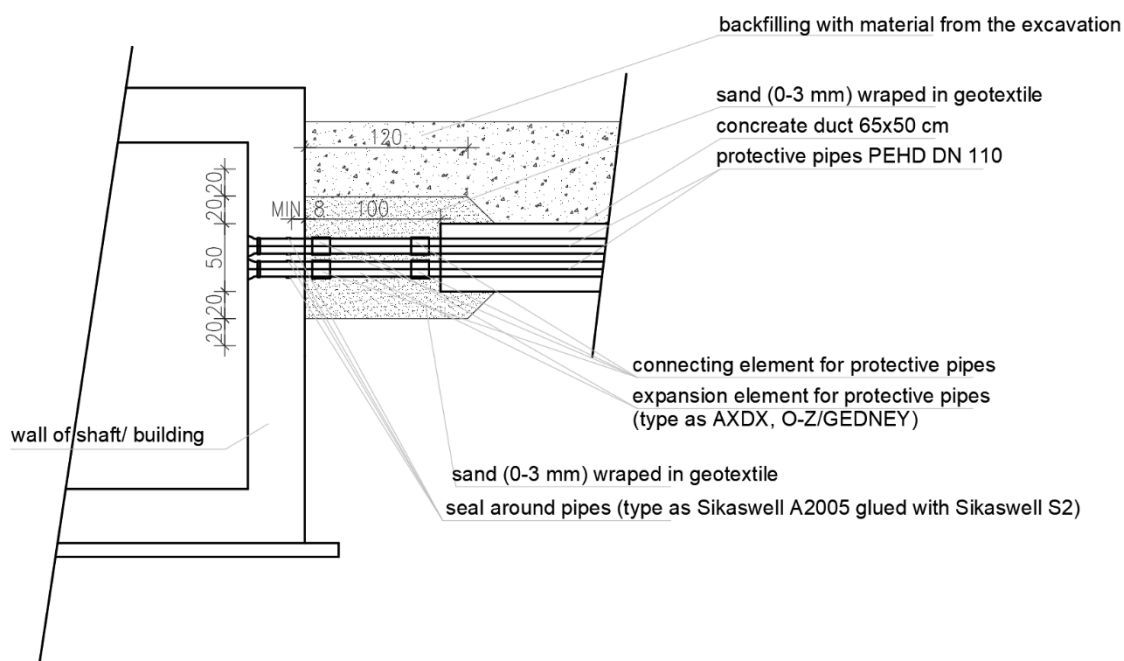


Figure 6: Watertight Pipe Penetration Detail at the Connection Between PEHD Pipe and Reinforced Concrete (RC) Walls of TP

General Requirements

The sealing system shall provide a watertight connection between the PEHD pipe and the reinforced concrete wall.

Installation shall be carried out by suitably trained personnel and in accordance with the manufacturer's current technical data sheets and recommendations.

Any alternative sealing system shall be subject to approval by the Engineer and shall demonstrate equivalent watertight performance.

Substrate Requirements:

Substrate Quality

The substrate shall be sound, clean, and free from any contaminants that could impair adhesion. Surfaces shall be dry or matt damp and free from dust, oil, grease, curing compounds, loose particles, and other deleterious materials.

Substrate Preparation – Existing Concrete

Rough concrete surfaces may create leakage paths and shall therefore be properly prepared before installation of the sealing system. Where surface irregularities cannot be adequately leveled using SikaSwell® S-2 adhesive, the surface shall be treated by application of a suitable Sika leveling mortar, or appropriate mechanical preparation methods, to provide a sound and even substrate for the installation of the SikaSwell® system.

Installation Procedure

1. Apply SikaSwell® S-2 adhesive in a continuous narrow bead with an approximately triangular cross-section of 12 mm × 12 mm onto the prepared substrate. Sufficient material shall be applied to fill and level any minor surface irregularities.
2. Firmly press the SikaSwell® Profile into the freshly applied adhesive. Installation of the profile shall be completed within 30 minutes of adhesive application at +23°C and 50% relative humidity.
3. Ensure continuous and complete contact between:
 - the SikaSwell® S-2 adhesive and the substrate; and
 - the SikaSwell® S-2 adhesive and the SikaSwell® Profile.
4. Allow the adhesive to be cured for a minimum of:
 - 12 hours before concrete placement; and
 - 24 hours where the concrete pouring height exceeds 500 mm.
5. Protect the installed sealing system from premature contact with water, including rain, groundwater, or cleaning water, until the concrete has been placed and adequately cured.
6. During concrete placement, ensure thorough compaction of the concrete around the SikaSwell® Profile to achieve dense, homogeneous concrete free from honeycombing, voids, or segregation.

8.14. Waste Management

During the execution of the Works, construction and demolition waste will be generated, together with smaller quantities of other waste streams. The Contractor shall ensure the separate collection, storage, handling, and disposal of all waste types, preventing mixing and avoiding any adverse impact on human health or the environment.

All waste management activities shall be carried out in accordance with the applicable waste management legislation, regulations, permit requirements, and environmental protection standards. Appropriate waste segregation, temporary storage, transportation, recovery, recycling, and disposal measures shall be implemented to minimize environmental impacts.

The location of temporary waste storage areas shall be defined in the Construction Site Organization Plan. The capacity and operation of these areas shall be adjusted in accordance with the construction schedule and anticipated waste quantities.

General Requirements

- Waste shall be segregated at source and stored separately according to its type and classification.
- Waste storage areas shall be clearly designated, adequately marked, and maintained in a safe and orderly condition.
- Waste shall be protected from wind dispersion, leakage, contamination, and unauthorized access.
- Waste shall be removed from the site regularly and transported only by authorized waste carriers.
- All transfers of waste shall be accompanied by the required documentation and records demonstrating legal disposal, recovery, or recycling.

Non-Hazardous Waste

Non-hazardous waste, including but not limited to:

- Metal scrap;
- Paper and cardboard;
- Plastics;
- Glass;
- Concrete and masonry waste;
- Excavated soil not suitable for reuse;
- Timber and packaging materials;

shall be collected separately by waste type and stored in designated containers or storage areas. Such waste shall be transferred to authorized recycling or waste management companies, accompanied by the required waste transfer documentation.

Hazardous Waste

Hazardous waste, including but not limited to:

- Metal waste contaminated with hazardous substances;
- Soil and stones containing hazardous substances;
- Contaminated asphalt materials;
- Packaging containing residues of hazardous substances or contaminated by hazardous substances;
- Waste oils, fuels, solvents, paints, varnishes, and related materials;
- Oily rags, absorbents, and contaminated personal protective equipment;

shall be handled, stored, and disposed of in accordance with applicable hazardous waste regulations.

Hazardous waste shall be stored in sealed, clearly labeled, and impermeable containers designed for the specific waste type. Larger contaminated materials or excavated soils containing hazardous substances shall be stored on impermeable surfaces with appropriate containment measures to prevent leakage and contamination of soil, surface water, or groundwater.

Any accidental spillage or release of hazardous substances shall be immediately contained, cleaned up, and reported in accordance with the site environmental management procedures.

Waste Hierarchy

The Contractor shall apply the principles of the waste hierarchy by prioritizing:

1. Prevention of waste generation;
2. Reuse of materials where practicable;
3. Recycling and material recovery;
4. Other recovery methods; and
5. Disposal only as a last resort.

Records of waste quantities, destinations, and recovery or disposal methods shall be maintained throughout the duration of the Works and made available to the Engineer upon request.

8.15. Sequence of Activities for Cable Duct System Construction

The installation of the cable duct system shall be carried out in the following sequence:

1. Geodetic surveying and setting out of the route, including identification and marking of all existing underground and above-ground utilities and crossings.
2. Cutting of existing concrete pavements where required.
3. Pit launched drilling beneath roads, the existing electrical installations, and other utilities where trenchless crossings are necessary.
4. Excavation and construction of shafts.
5. Mechanical excavation of trenches to the required dimensions and levels.
6. Manual excavation in the vicinity of existing installations, structures, and services, ensuring that no damage occurs.
7. Leveling and compaction of the trench bottom.
8. Placement and compaction of a concrete bedding layer of minimum strength class C12/15.
9. Core drilling or cutting of openings in existing concrete walls and structures where required.
10. Installation, alignment, and welding of new PEHD ducts, followed by construction of protective concrete encasement blocks using concrete class C25/30, where specified.
11. Geodetic survey and recording of the installed duct route.
12. Watertight sealing of all penetrations through existing concrete walls and structures.
13. Backfilling of trenches with suitable material in layers, including compaction to the specified density, and installation of a warning tape located approximately 500 mm above the top of the duct.
14. Reinstatement of all disturbed surfaces, including concrete pavements, asphalt layers, topsoil, and landscaped areas, to their original condition or as specified in the design documentation.

9. Attachments

Drawings:

E-303-100A	Layout of underground electrical installations on geodetic surveying
D-436-011	Longitudinal sections of underground electrical installations
D-436-012	Formwork plan for electrical manhole JE156
D-436-013	Formwork plan for electrical manhole JE157
D-436-014	Formwork plan for electrical manhole JE158
D-436-015	Formwork plan for electrical manhole JE159
D-436-016	Formwork plan for electrical manhole JE160
D-436-017	Formwork plan for electrical manhole JE161
B-436-018	Manhole and concrete duct protection block layout
B-436-019	Steel reinforcement layout for concrete duct protection block layout
D-436-020	Steel reinforcement layout for electrical manhole JE156
D-436-021	Steel reinforcement layout for electrical manhole JE157
D-436-022	Steel reinforcement layout for electrical manhole JE158
D-436-023	Steel reinforcement layout for electrical manhole JE159
D-436-024	Steel reinforcement layout for electrical manhole JE160
D-436-025	Steel reinforcement layout for electrical manhole JE161
B-436-026	Cross section of the trench for electrical installations
B-436-027	Expansion joint of concrete cable block
C-436-028	Transformer station TP1 Floor plans and cross-sections
1667-1-33-108	Transformer station 630 kVa -TP3 Floor plans and cross-sections
E-216-015	Underground and underfloor ducts
B-436-029	Transformer station TP1- Steel reinforcement outside foundations
E-303-100A	Yard Miscellaneous Installation
CIV-01	Foundation of existing lamp - formwork and reinforcement plan
D-436-030	Transformer station TP1- Steel construction- inside transformer room-GA drawing
D-436-031	Transformer station TP1- Steel construction- inside transformer room-Fabrication drawing
D-436-032	Transformer station TP1- Steel construction- inside electrical cabinets room-GA drawing
D-436-033	Transformer station TP1- Steel construction- inside electrical cabinets room- Assemblies
D-436-034	Transformer station TP1- Steel construction- inside electrical cabinets room- Elements