CONCRETE STRUCTURE WATERPROOFING

Production schedule

for design
waterproofing
corrosion protection of monolithic
and prefabricated concrete
and reinforced concrete structures

Moscow 2008

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1. FOREWORD

This Production Schedule represents practical guide for design, waterproofing and corrosion protection of monolithic and prefabricated concrete and reinforced concrete structures subject to higher requirements for waterproofness and corrosion resistance.

Regulatory norms have been devised with reference to recent scientific achievements in the sphere of waterproofing and corrosion resistance of building concrete and reinforced concrete structures.

The Schedule includes the following publications:

- Description and Manual to use "Penetron" waterproofing materials of penetration type;
- Description and Manual to use "Penetron Admix" waterproofing additive to concrete mix;
- Description and Manual to use "Penebar" waterproofing gasket;

As well as requirements to components of building structures and facilities for their protection.

2. NORMATIVE AND TECHNICAL DOCUMENTS

This Schedule is prepared with reference to the following normative and technical documents:

Specifications "Dry, dispersing waterproofing mixes of "Penetron" system, TU 5745-001-77921756-2006;

Specifications "Penebar" waterproofing gasket, TU 5772-001-77919831-2006;

SNiP 2.03.01-84 "Concrete and reinforced concrete structures";

SNiP 2.03.11-85 "Corrosion protection of building structures NIIJB";

SNiP 2.06.01-86 "Hydraulic structures. Design Guidelines:

SNiP 2.08.02-89 "Building Code. Public buildings and Facilities";

Reference publication to SNiP 2.08.02-89 "Design of water pools";

SNiP 3.03.01-87 "Bearing and fencing structures";

SNiP 3.04.01-87 "Insulting and finishing coats";

SNiP 3.04.03-85 "Corrosion protection of building structures and facilities";

SNiP 12-03-2001 "Labour safety in construction", Part 1;

SNiP 12-04-2001 "Labour safety in construction", Part 2;

GOST 310.3-76 "Cements. Methods for identification of normal density, curing times and uniformity of volume changes";

GOST 7473-94 "Concrete mixes";

GOST 8735-88 "Sand for construction. Test methods";

GOST 10060.0-95 "Concrete. Methods for identification of frost-resistance properties. General requirements";

GOST 10180-90 "Concrete. Methods for identification of strength by test samples";

GOST 12730.0-78 "Concrete. General requirements to methods for identification of density, moisture content, water absorption, porosity and waterproofness";

GOST 12730.3-78 "Concrete. Methods for identification of water absorption";

GOST 12730.5-84 "Concrete. Methods for identification of waterproofness";

GOST 28570-90 "Concrete. Methods for identification of strength by samples of structures";

GOST 28574-90 (ST SEV 6319-88) "Corrosion protection in building industry. Concrete and reinforced concrete structures. Test methods for protection coats";

GOST 22690-88 "Concrete. Identification of strength by mechanical NDT inspection methods";

GOST 31189-2003 "Dry mixes for construction. Classification".

3. PRODUCTION SCHEDULE SCOPE OF APPLICATION

This Production Schedule covers design and works aimed at higher waterproofing and corrosion resistance of concrete and reinforced concrete structures, buildings and facilities of commercial and industrial purposes, objects of transport infrastructure, hydraulic facilities, objects of CD and ER with application of Penetron system materials of penetration type.

4. BRIEF INFORMATION ABOUT MATERIALS

Penetron system of materials represents a common title of a system consisting of six materials applicable for waterproofing of prefabricated and monolithic concrete and reinforced concrete structures;

"Penetron": waterproofing material of deep penetration action designed for considerable increase of waterproofness and prevention of capillary moisture penetration through concrete.

"Penecrete": waterproofing material for joints to eliminate droplet leaks and prevention of water filtering through cracks, welds, joints, service inlets, interfaces and adjoining elements.

"Penebar": waterproofing material for joints designed for prevention of water filtering through welds, service inlets, interfaces and adjoining elements.

"Peneplug": water-repellent waterproofing material designed for prompt plugging of pressure fountain leaks.

"Waterplug": water plugging waterproofing material designed for prompt plugging of pressure fountain leaks.

"Penetron Admix": waterproofing additive to concrete mix for considerable increase of concrete waterproofness, frost-resistance and strength properties.

Each material is standardised, therefore integrated use of these materials is required.

5. BRIEF INFORMATION ABOUT PRODUCER

ICS/Penetron International Ltd (USA), designer and the first producer of Penetron system materials is a global leader in production of waterproofing materials for waterproofing, concrete protection and recovery. Company is certified according to ISO 9001:2000 Quality Management System. System of Penetron materials is used on various objects of construction in 92 countries for more than 50 years.

In Russia, Penetron system materials are used since 1989. In 2004, the first production lines of Waterproofing Plant were commissioned (Ekaterinburg). In 2006, at the same time with increase of production facilities, the Plant of waterproofing materials "Penetron" was certified according to ISO 9001:2000 Quality Management System in international system and GOST R system.

All materials produced by the Plant of waterproofing materials "Penetron" were tested in leading laboratories of Russia, which is confirmed by required certificates and reports. It enables to use Penetron system materials effectively and on legal grounds during design, production and repair of concrete and reinforced concrete structures.

6. DESCRIPTION AND PURPOSE OF MATERIALS

6.1 PENETRON: DESCRIPTION AND PURPOSE

Description: Dry mix. It consists of special cement, quartz sand of specific gain-size composition and patented active chemical components.

Purpose. Waterproofing of prefabricated and monolithic reinforced concrete structures by the **whole thickness**, surfaces and plaster layers made of sand and cement slurry type M150 or higher. IN addition, "Penetron" material is used in combination with "Penecrete" material to plug capillary suction during damaged horizontal waterproofing between concrete foundation and wall. As an auxiliary material, "Penetron" is used for waterproofing of cracks, welds, joints, interfaces, adjoining elements, service inlets in combination with "Penecrete" material, as well as to liquidate pressure leaks in combination with "Peneplug" or "Waterplug" material.

Specific features. "Penetron" is applied on **carefully moistened** surface of concrete structure at any side (inner or outer), irrespective of water pressure direction (positive or negative). Using of "Penetron" material allows preventing of water penetration through concrete structure with width of pore opening and cracks up to 0.4 mm. This material is effective even with available high hydrostatic pressure. Using of "Penetron" material provides for concrete protection against effects of corrosive mediums: acids, alkali, waste and ground waters and seawater. After treatment with "Penetron" material, concrete acquires resistance to carbonates, chlorides, sulphates, nitrates, etc. (Annex 2), as well as bacteria, fungi, algae and sea organisms.

Concrete retains all acquired waterproofing and strength properties even with available high radiation effects. Using of "Penetron" material makes possible to improve concrete frost resistance and strength, as well as to give it sulphates resistance properties.

Attention! "Penecrete" material is used for waterproofing of cracks, joints, welds, interfaces, adjoining elements and service inlets (12.2); "Peneplug" or "Waterplug" (12.4) is used for plugging of pressure leaks.

6.2 PENECRETE: DESCRIPTION AND PURPOSE

Description: Dry mix. It consists of special cement, quartz sand of specific grain-size composition and patented active chemical components.

Purpose: Waterproofing of cracks, joints (except for expansion joints), welds, interfaces, adjoining elements, service inlets in statically loaded prefabricated and monolithic concrete structures. Using for plugging of droplet leaks through joints, welds, cracks, etc. is feasible.

Specific features. It differs by easy placement, high strength, zero settlement, high adhesion to concrete, metal, brickwork and stonework.

6.3 "PENEBAR": DESCRIPTION AND PURPOSE

Description: Flexible self-expansion bundle of rectangular cross-section, including special composite materials. When interacting with water, it is capable to swell within restricted space up to 300%. It retains flexibility in case of negative temperatures.

Purpose. This material is used for pressurisation and waterproofing of horizontal and vertical working and structural joints in underground and surface concrete structures, as well as points of service inlet penetrations (plastic including) in concrete structures under construction and in use.

Specific features. This material possesses high resistance to hydrostatic pressure and provides for pressurisation of welds, joints, etc. Properties of waterproofing remain unchanged in time and service life is unlimited. "Penebar" promptly and easy in installation, has no requirements for special accessories. Installation of "Penebar" waterproofing gasket is allowed at any weather conditions, throughout a year.

6.4 PENEPLUG: DESCRIPTION AND PURPOSE

Description. Dry mix. It consists of special cement, quartz sand of specific grain-size composition and patented active chemical components.

Purpose. Prompt elimination of pressure leaks in structures made of concrete, brickwork and stonework. This material is used, when other materials are washed out by water before curing is complete.

Specific features. It differs by prompt curing (**40 s**), ability to expand during curing. It may be used under water in some cases.

6.5 WATERPLUG: DESCRIPTION AND PURPOSE

Description. Dry mix. It consists of aluminate cement, quartz sand of specific grain-size composition and patented active chemical components.

Purpose. Prompt elimination of pressure leaks in structures made of concrete, brickwork and stonework. This material is used, when other materials are washed out by water before curing is complete.

Specific features. It differs by prompt curing (**3 min**), ability to expand during curing. It requires additional treatment by "Penetron" material.

6.6 PENETRON ADMIX: DESCRIPTION AND PURPOSE

Description. Dry mix. It consists of special cement, and patented active chemical components.

Purpose. Waterproofing of prefabricated and monolithic concrete and reinforced concrete structures/items on the **whole thickness** at the stage of concreting/production.

Specific features. Using of waterproofing admixture "Penetron Admix" (as primary form of concrete protection) makes it possible to eliminate additional waterproofing of structure/item after strength setting. Material is added to concrete mix during mix preparation. Using of "Penetron Admix" material allows preventing of water penetration through concrete structure with a width of pore opening and cracks up to 0.4 mm. Using of "Penetron Admix" additive is effective even with available high hydrostatic pressure. Using of "Penetron Admix" increases waterproofness and frost-resistance of concrete, as well as resistance to sulphates. Using of "Penetron Admix" protects concrete against effects of corrosive mediums: acids, alkali, waste, ground waters and seawater.Concrete with "Penetron Admix" acquires

resistance to effects of carbonates, chlorides, sulphates, nitrates, etc (Annex 2), as well as bacteria, fungi, algae and sea organisms. Concrete retains all acquired waterproofing and strength characteristics even with available high radiation effects.

Note: "Penetron Admix" is compatible with other additives, normally used during concreting (plasticizers, frost-resistant additives, etc.).

7. PRINCIPLE OF MATERIAL PERFORMANCE

7.1 REASONS OF CONCRETE WATER PERMEABILITY

Concrete, which is prepared according to traditional technology, represents a structure penetrated by pores, capillaries and micro cracks. Presence of developed pore network, capillaries and micro cracks in concrete structure is stipulated by a set of factors: water evaporation during concrete curing, insufficient concrete compaction during filling; internal stresses due to concrete settlement during curing, etc.

To avoid direct water filtering through concrete structure, it may be sufficient to treat concrete by "Penetron" material or to add "Penetron Admix" to concrete mix. As a result of "Penetron" or "Penetron Admix" use, pores, capillaries and micro cracks in concrete are filled by insoluble and chemically resistant crystals. Using of Penetron system materials allows increasing of concrete waterproofness index by six or more stages. For example, if the primary index of concrete waterproofness corresponds to W2, after using of "Penetron" or "Penetron Admix" additive, this index gradually grows for at least to W14.

7.2 PENETRON: PRINCIPLE OF OPERATION

"Penetron" material action is based on four basic principles: osmosis, Brownian motion, response in hard state and forces of fluid surface tension.

When liquid solution of "Penetron" is applied on wet concrete surface, high chemical potential is generated and inner concrete structure retains low chemical potential. Osmosis strives to level up potential difference, osmotic pressure is created. Owing to presence of osmotic pressure, active chemical components of "Penetron" material migrate deeply in concrete structure. The higher is moisture content of concrete structure, the more effective is penetration of active chemical components deep in concrete. This process flows both at positive and negative water pressure. The depth of penetration for "Penetron" active chemical components on continuous front achieves several tens of centimetres.

After penetration deep in concrete structure, "Penetron" active chemical components are dissolved in water and start reaction with ion complexes of calcium and aluminium, metal oxides and salts within concrete. During these reactions, more complex salts are formed, which are capable to interact with water and to create insoluble crystal hydrates. Network of these crystals fill pores, capillaries and micro cracks up to 0.4 mm by width. Moreover, crystals represent component of concrete structure.

Filling of pores, capillaries and micro cracks by insoluble crystals make the structure resistant to water penetration, since forces of fluid surface tension start to act. Network of crystals, which filled capillaries prevents water filtering even with available high hydrostatic pressure. Moreover, concrete retains vapour permeability.

Rate of crystal formation and depth of penetration for active chemical components depends on multiple factors, in particular, concrete density, porosity, moisture content and ambient temperature. Without water, process of crystal formation is suspended. When water appears (for example, with higher hydrostatic pressure), process of crystal formation resumes, i.e. after treatment by "Penetron", concrete acquires capability for "self-curing".

7.3 PENECRETE: PRINCIPLE OF OPERATION

Action of "Penecrete" material is based on a principle of settlement-free, plasticity, water permeability and high adhesion to concrete, stonework, brickwork and metal surfaces.

7.4 PENEBAR: PRINCIPLE OF OPERATION

Penebar action is based on material capability to expand in volume in water environment within limited volume for free swelling and to rate dense watertight gel, which forms a barrier for moisture penetration.

7.5 PENEPLUG (WATERPLUG): PRINCIPLE OF OPERATION

Action of "Peneplug" and "Waterplug" is based on capability for prompt setting during interaction with strong water head and capability of prompt expansion.

7.6 PENETRON ADMIX: PRINCIPLE OF OPERATION

Action of Penetron Admix material is based on two principles: reaction in hard state and force of liquid surface tension.

Active chemical components of "Penetron Admix" uniformly distributed by concrete depth dissolve in water and start reaction with ion complexes of calcium and aluminium, metal oxides and salts within concrete. During these reactions, more complex salts are formed, which are capable to interact with water and to create insoluble crystal hydrates. Network of these crystals fill pores, capillaries and micro cracks up to 0.4 mm by width. Moreover, crystals represent component of concrete structure.

Filling of pores, capillaries and micro cracks by insoluble crystals make the structure resistant to water penetration, since forces of fluid surface tension start to act. Network of crystals, which filled capillaries, prevents water filtering even with available high hydrostatic pressure.

Concrete with "Penetron Admix" acquires waterproofness and capability for "self-curing", while at the same time retaining vapour permeability.

8. SPECIFIC FEATURES OF PENETRATION TYPE MATERIALS OF PENETRON SYSTEM

- Materials of Penetron system are used on wet surface only; there is no requirements for preliminary surface drying, which considerably reduces costs during works;
- Technology for application of materials is not complicated and has no requirement for protracted surface preparation;

- materials are easy for application, only make sure that instructions for use are adhered to;
- using of Penetron system materials are equally effective both on the outer and inner surface of structure, irrespective of water pressure direction;
- using of Penetron materials results in considerable upgrade of concrete brand in terms of waterproofness, growth of concrete frost-resistance properties and strength;
- in case of mechanical damages on treated surface, acquired high waterproofing and protection properties of concrete structure are retained;
- treated concrete acquires a capability for "self-curing";
- using of these materials enables the user to provide reliable waterproofing for the whole service life of concrete structure;
- the most effective and cost-saving way of application compared with other types of waterproofing;
- concrete pre-treated with "Penetron" materials or concrete with "Penetron Admix" additive retains vapour permeability;
- concrete pre-treated with "Penetron" materials or concrete with "Penetron Admix" additive acquires corrosion resistance to corrosive mediums;
- materials are used for structures under construction and existing structures of all types of crack resistance;
- using of these materials allows the user to prevent corrosion of rebars in reinforced concrete;
- materials are used even under conditions of high hydrostatic pressure;
- pre-treated concrete retains all acquired waterproofing properties even under conditions of high radiation effects;
- materials are certified for use in tanks for potable water;
- materials are not toxic, non-combustible, not explosion hazardous and safe in terms of radiation;
- materials have long shelf life: 18 months from the date of manufacturing provided that original packing remains undamaged.

9. SCOPE OF APPLICATION FOR PENETRON SYSTEM MATERIALS

Materials are used for arrangement and recovery of waterproofing in monolithic and prefabricated concrete and reinforced concrete structures under construction and existing, of all categories of crack resistance, at least M100.

Some examples of structures, where materials of Penetron system are used:

Hydraulic structures:
Tanks (exposed, banked up, etc.);
Water pools (exposed and sheltered);
Wells;
Docks;
Quays;
Structures of water purification facilities (aeration tanks, settlement tanks, sewers, pump stations, etc.);
Concrete dikes;
Dams, etc.

Object of civil construction:
Foundations;
Basement premises;
Underground facilities (car parks, garages, crossover bridges, etc.);
Balconies;
Roofs in use and not in use;
Elevator wells;
Vegetable pits, etc.

Structures of industrial and agricultural purpose:
Production premises;
Basins of cooling towers;
Storage rooms;
Smoke stacks;
Mines;
Hoppers;
Concrete structures subject to corrosive effects, etc.

Objects of CD and ER:
Shelters;
Fire tanks, etc.

Objects of power engineering:
UNF (used nuclear fuel) decay pools;
Pump stations;

UNF vaults;
Ducts;
Fuel supply ramps;
Cable galleries;
Concrete structures subject to radiation effects, etc.

Objects of transport infrastructure:
Tunnels (highway, railroad, pedestrian, etc.);
Metros;
Components of bridges and roads, etc.

10. CONCRETE SURFACE PREPARATION BEFORE APPLICATION OF PENETRON SYSTEM MATERIALS

Clean the concrete surface to remove dust, dirt, oil products, laitance, salt spots, concrete gunite, plaster layer, tiles, paint and other materials preventing penetration of active chemical components of Penetron materials. High-pressure water jet plant or other suitable mechanical equipment should make cleaning of concrete surfaces (for example, metal wire brush). Smooth and polished surfaces should be treated by weak acid solution and washed by water within one hour. Excessive water on horizontal surface after using of high-pressure water jet plant must be removed by special vacuum cleaner.

U-shaped toothing of cross-section 25x25-mm minimum must be made along the whole length of cracks, welds, joints, interfaces and adjoining components and around service inlets. Clean toothing by metal wire brush. Remove loose concrete layer (if any).

Cavities of pressure leaks shall be expanded by pneumatic pick at width 25 mm minimum and at depth 50 mm minimum with in-deep expansion (as far as practicable, in the form of a "dovetail"). Clean inner leak cavity to remove loose and peeled off concrete layer.

Attention! Before using of Penetron materials, carefully moisten concrete until complete saturation of concrete structure by water.

11. PREPARATION OF COMPOUNDS

11.1 PENETRON: COMPOUND PREPARATION

Mix dry mixture with water in the following ratio: 400 grams of water per kg of "Penetron" material or 1 part of water per 2 parts of "Penetron" material by volume. Pour water in dry mixture (not vice versa). Mix during 1-2 minutes manually or using low-speed drill. Type of prepared compound: liquid cream-like slurry. Prepared volume should be sufficient for use during 30 minutes. During use, the slurry needs regular mixing to retain primary consistency. Refilling of water in the slurry is not allowed.

11.2 PENECRETE: COMPOUND PREPARATION

Mix dry mixture with water in the following ratio: 200 grams of water per kg of "Penecrete" material or 1 part of water per 4 parts of "Penecrete" material by volume. Pour water in dry mixture (not vice versa). Mix during 1-2 minutes manually or using concrete mixer. Type of prepared compound: dense, modelling clay-like, easy-for-placement slurry. Prepared volume should be sufficient for use during 30 minutes. During use, the slurry needs regular mixing to retain primary consistency. Refilling of water in the slurry is not allowed.

11.3 PENEBAR: COMPOUND PREPARATION

Material is ready for use.

11.4 PENEPLUG (WATERPLUG): COMPOUND PREPARATION

Mix a handful of dry mix with water in the following ratio: 150 grams of water per kg of "Peneplug" ("Waterplug") or 1 part of water per 6 parts of "Peneplug" (5 parts of "Waterplug") by volume. Optimum water temperature is +20°C. Depending on leak activity, ratio may be varied. In case of strong leak, volume of water should be reduced to the following ratio: 1 part of water per 7 parts of "Peneplug" (6 parts of "Waterplug") by volume. Type of prepared compound: "dry ground". Prepared volume should be sufficient for use during 30 minutes (for "Peneplug") and 2-3 minutes (for "Waterplug"), since these slurry is subject to prompt setting.

11.5 PENETRON ADMIX: COMPOUND PREPARATION

This material is added to concrete mix in the form of aqueous solution. Mix estimated volume of additive with water until weak solution (1 part of water per 1.5 parts of dry mix by mass) is obtained. Pour water in dry mix (not vice versa). Mix it during 1-2 minutes using low-speed drill. Prepared volume should be sufficient for use during 5 minutes.

12. TECHNOLOGY OF WATERPROOFING WITH APPLICATION OF PENETRON SYSTEM MATERIALS

Before application of Penetron materials, concrete surface needs pre-treatment according to par. 10.

12.1 WATERPROOFING OF CONCRETE STRUCTURAL COMPONENTS

Attention! Before application of Penetron materials, carefully moisten concrete surface.

Vertical and horizontal (ceiling including) concrete surfaces must be treated by "Penetron" solution to remove and prevent capillary water filtering.

Complete surface treatment (par. 10) and apply "Penetron" slurry (par. 11.1) in two layers by brush with synthetic fibre or slurry pump with atomiser. The first coat of "Penetron" material is applied on moistened concrete. The second coat is applied on fresh first coat after setting. Moisten surface before application of the second coat.

Attention! "Penetron" slurry is applied uniformly on the whole surface, without gaps.

"Penetron" material consumption if re-calculated into dry mix for application in two coats varies within 0.8 kg/m^2 to 1.1 kg/m^2. Increase of "Penetron" consumption from 0.8 kg/m^2 to 1.1 kg/m^2 is possible on uneven surfaces with substantial cavities or nicks.

Attention! All cracks, joints, welds, adjoining components, service inlets shall be insulated with application of "Penecrete" material (par. 12.2.1). In case of pressure leaks, use "Peneplug" or "Waterplug" material (par. 12.4).

12.2 WATERPROOFING OF CRACKS, JOINTS, WELDS, INTERFACES, ADJOINING AND SERVICE CONDUIT INLETS

Waterproofing to prevent water filtering through welds, joints, interfaces, adjoining elements and service inlets is made with the use of "Penecrete" and "Penebar". Waterproofing of cracks is made with "Penecrete" material only.

Works using "Penecrete" material are possible at the stage of new construction only and in the process of repair works on existing structure, using of "Penebar" gasket is possible on monolithic structures during concreting only, at the stage of construction.

12.2.1 PENECRETE

Prepared toothing is moistened and primed with "Penetron" slurry (par. 11.1) in one coat. Consumption of "Penetron" material if re-calculated into dry mix is 0.1 kg/r.m. for toothing 25x25 mm. Prepared toothing is densely filled with "Penecrete" slurry (par. 11.2) using spatula or auger slurry pump. Thickness of applied coat of "Penecrete" slurry per one cycle shall not exceed 30 mm. If toothing depth is higher, "Penecrete" slurry is applied in several cycles. To reduce consumption of "Penecrete" material for waterproofing of toothing cross-section over 30x30 mm, fine and washed crushed stone (fraction size 5-10 mm) may be added to the slurry up to 50% of volume. Toothing filled with "Penecrete" material and adjoining areas should be moistened and treated by "Penetron" slurry in two coats (par. 12.1).

Consumption of "Penecrete" material if re-calculated into dry mix for toothing 25x25 mm is 1.5 kg/r.m. It should be noted that consumption of "Penecrete" material varies proportionally along with increase of toothing dimensions.

12.2.2 PENEBAR

Before works using "Penebar" waterproofing gasket, make sure to remove adhesive paper from the bundle. Place "Penebar" on concrete surface densely, without gaps and secure to avoid displacements by securing grid and dowels of 40-50 mm at spacing of 250-300 mm. Connect bundles in butt joints, cut off bundle ends at 45° to arrange continuous layer.

"Penebar" waterproofing gasket, with sticky surface facing the sleeve surface shall tightly wrap all sleeves for service inlets passing through fencing elements of the structure. Sleeve surface must be dry and clean. Install "Penebar" waterproofing gasket directly before formwork installation. Spacing from "Penebar" bundle to the structure edges must be at least 50 mm.

"Penebar" waterproofing gasket may be placed on wet concrete surface. Besides, make sure to remove stagnant water from concrete surface.

During repair of waterproofing in service inlet points, use "Penebar" waterproofing gasket in combination with "Penetron" and "Penecrete" materials (Annex 4).

12.3 WATERPROOFING OF SERVICE HOLES AFTER FORMWORK REMOVAL

During arrangement of waterproofing in points of service inlets from securing guys of panel formwork, "Penecrete" and "Penetron" slurry is used.

Dismantle plastic sleeve, use a drill or other suitable tools. Clean a hole (by compressed air or "pipeline scraper") to remove dust. Fill a hole by foamed PE bundle pieces (for hole 20 mm in diameter, a bundle of 30 mm in diameter is required) or installation foam so that cavities at depth of 20-25 mm are left by hole edges from the outer or inner side. After that, obtained cavities should be moistened.

Prepare "Penecrete" slurry (par. 11.2) of putty consistency. Fill cavities by "Penecrete" slurry by metal putty or manually in rubber gloves, strongly press and compact the slurry. Consumption of "Penecrete" material for a cavity of 20 mm in diameter and depth of 20-25 mm is 0.03 kg, if re-calculated into dry mix.

Prepare "Penetron" slurry (par. 11.1), moisten surfaces filled with "Penecrete" slurry and adjoining areas in radius of 20 mm. After that, use a brush and apply a coat of "Penetron" slurry. Consumption of "Penetron" material is 1 kg/m^2.

12.4 LIQUIDATION OF PRESSURE LEAKS

Active fountain pressure leaks should be eliminated using "Peneplug" or "Waterplug" material. Slurries of these materials differ by short setting time, therefore use them as soon as possible.

Prepare leak cavity (par. 10), apply maximum force and press "Peneplug" or "Waterplug" slurry (par. 11.4) in the leak cavity. Depending on concrete surface temperature and water filtering force, this pressure should be applied during 40 to 60 seconds during use of "Peneplug" material or 2 to 3 minutes for "Waterplug" material. The lower water and surface temperature, the slower is slurry setting. While eliminating pressure leaks through long vertical cracks, (joint, weld, adjoining element), work should be started from the highest crack point (joint, weld, adjoining element).

Leak cavity is filled with slurry only. In case of overfilling, excessive slurry volume should be removed without delay. While using "Waterplug", make sure to treat the cavity of plugged leak by "Penetron" solution. When using "Peneplug" such pre-treatment is not required.

Irrespective of material being used, remaining volume in the leak cavity should be filled with "Penecrete" slurry. Leak cavity filled with "Penecrete" slurry and adjoining areas must be treated by "Penetron" slurry in two coats (par. 12.1).

Consumption of "Peneplug" or "Waterplug" slurry if re-calculated into dry mix is 1.9 kg/dm^3.

12.5 ARRANGEMENT OF NEW HORIZONTAL WATERPROOFING BETWEEN CONCRETE FOUNDATION AND WALL MADE OF POROUS MATERIAL

In case of new construction, horizontal concrete surface of foundation must be treated by "Penetron" slurry (par. 11.1) for arrangement of horizontal waterproofing between concrete foundation and wall made of porous material (brick, wood, cellular concrete, etc.) to provide for a waterproofing barrier preventing capillary moisture suction.

12.6 RECOVERY OF HORIZONTAL WATERPROOFING BETWEEN CONCRETE FOUNDATION AND WALL MADE OF POROUS MATERIAL

To recover horizontal waterproofing (elimination of capillary suction) between concrete foundation and wall, make sure to use "Penetron" and "Penecrete" materials.

Drill holes of 20-25 mm in diameter in concrete foundation (from inner or outer side) through 30-45 degrees to level plane. Spacing between holes horizontally is 200-300 mm and 150-200 mm by vertical. Drilling depth must be at least 2/3 of foundation depth.

Wash drilled holes by water, where required, to saturate concrete with moisture. Fill holes with prepared "Penetron" slurry (par. 11.1) using a funnel. Carefully compact slurry in a hole. Remaining volume must be filled by "Penecrete" slurry (par. 11.2).

Attention! In case of loose (hollow) concrete structure, make sure to reinforce foundation by injection of cement-based settlement-free slurry.

12.7 WATERPROOFING OF CONCRETE STRUCTURES AT THE STAGE OF CONCRETING

"Penetron Admix" is used for waterproofing of concrete and reinforced concrete structures (items) at the stage of concreting. Using of "Penetron Admix" allows the user to obtain extra dense concrete with a high category of waterproofness, frost-resistance and strength.

"Penetron Admix" dry mix mixing ratio is 1% of dry mix from cement mass in concrete mixture. If cement volume in concrete is unknown, estimated consumption of "Penetron Admix" per cubic meter of concrete is 4 kg.

Attention! It is important to obtain a uniform "Penetron Admix" mixture with concrete. Do not add dry "Penetron Admix" directly to concrete mix.

Attention! All joints, welds, adjoining components and service inlets must be insulated using "Penebar" waterproofing gasket, or "Penecrete" material. Cracks must be insulated by "Penecrete" material (par. 12.2).

12.7.1 During application on construction site:

Pour prepared "Penetron Admix" slurry (par. 11.5) in concrete mixer truck or concrete truck and continue mixing for at least 10 minutes. Further concrete mix is poured in accordance with rules of concreting.

To avoid probable increase of concrete mobility, make sure to prepare concrete with reduced mobility (normally, one step below requirement).

12.7.2 Application in concrete manufacturing facility:

Add estimated volume of "Penetron Admix" material in water, carefully mix during 1-2 minutes. Mix concrete mixture according to standard technology. In some cases, adding of "Penetron Admix" dry additive into batcher for dry mixtures or in crushed stone during weighing is allowed. In this case, cement is the last for dosing.

Additive is effectively used in combination with other known additives without limitations and has no effects on concrete physical and mechanical properties, except for increase of concrete waterproofness, frost resistance and strength.

12.8 WATERPROOFING OF BRICKWORK AND STONEWORK STRUCTURES

During arrangement of waterproofing in structural components made of brick or stone, the surface must be plastered first and treated by "Penetron" slurry (par. 12.1). If the surface is plastered, the following mandatory conditions shall be observed:

- Sand and cement slurry **at least M150** is used for plastering only;

Attention! Using of known slurries and gypsum plaster is not allowed.

- Plastering is made over brickwork mesh only (mesh size 50x50 mm or 100-100 mm), reliably secured on the surface;
- Clearance between brickwork mesh and brick base must be at least 15 mm;
- Thickness of plaster coat must be at least 40 mm;
- Structure of plaster coat must be dense, without air gaps;
- It is recommended to perform plastering without interruptions to avoid numerous working joints.

Before treatment by "Penetron" material, plastered surfaces must be conditioned for at least 24 hours (in accordance with requirements to plastered surfaces).

Consumption of "Penetron" material if re-calculated into dry mix with consideration of two coats is 0.8 kg/m^2.

Attention! All cracks, joints, welds, adjoining elements and service inlets must be insulated by "Penecrete" material (par. 12.2.1). In case of pressure leaks, use "Peneplug" or "Waterplug" material (par. 12.4).

13. TREATED SURFACE HANDLING

Treated surfaces must be cleaned to avoid mechanical effects and negative temperatures for 3 days. Moreover, observe that surfaces treated by Penetron system materials remain wetted during 3 days, cracking and peeling of coat must be avoided.

To moisten treated surfaces, normally the following techniques are used: water spraying or concrete surface covering by PE film.

While handling of surface treated from the side of water pressure, it is recommended to extend wetting period to 14 days.

14. APPLICATION OF DECORATIVE FINISH COAT

Application of paint or finish materials on the structural surface pre-treated by Penetron materials is recommended after 28 days after pre-treatment. Hold time may be reduced or extended depending on requirements of specific finish material type for allowed concrete wetting.

Attention! Before application of decorative coat on surfaces pre-treated by Penetron materials, make sure to clean the surface mechanically to improve cohesion (adhesion) by high-pressure water jet (for materials applied on wetted concrete) or a metal wire brush (for materials applied on dry concrete surface).

15. METHODS AND FACILITIES TO CONTROL QUALITY OF COMPLETED WORKS

Works for arrangement or recovery of waterproofing for concrete and reinforced concrete structures with application of penetration type Penetron materials must be in strict compliance with Production Schedule for design, waterproofing and corrosion protection of monolithic and prefabricated concrete and reinforced concrete structures.

Measurement of waterproofness increase by accelerated method of NDT inspection, type "AGAMA" as per GOST 12730.5-84 "Concrete. Methods for waterproofness identification" is a basic inspection method to control quality of works for arrangement or recovery of waterproofing in concrete and reinforced concrete structures. Measurements are completed before

start of waterproofing operations and upon their completion (however at least in 28 days after application of Penetron materials).

Identification of compression strength increase by accelerated NDT inspection method of impact pulse "OMSH-1" as per GOST 22690-88 "Concrete. Identification of strength by mechanical methods of NDT inspection" is an additional method of inspection to check quality of completed works.

All measurement results are recorded in technical control log (Annex 5).

16. PACKING, STORAGE AND TRANSPORT

Penetron materials are packed in hermetically sealed plastic buckets. Each bucket has a label with the following information: producer, product name, lot number, net weight, date of manufacture, warranty storage period and instructions for use.

Warranty storage period is 18 (eighteen) months from the date of production provided that original packing remains sealed. Storage inside premises of an humidity is allowed at temperature -80°C to +80°C.

Delivery by any type of transport is allowed.

17. QUALITY GUARANTEES

ICS/Penetron International Ltd. (USA) and Plant of waterproofing materials "Penetron" (Russia) guarantee compliance of Penetron materials with specifications 5745-001-77921756-2006 "Dry mixes, waterproofing, disperse type of "Penetron" system, as well as all modern standards. The company guarantees that materials of Penetron system contain all components in relevant ratios.

Using of Penetron materials must be in strict compliance with Production Schedule for design, waterproofing and corrosion protection of monolithic and prefabricated concrete and reinforced concrete structures.

18. ACCIDENT PREVENTION PROVISIONS

During works for waterproofing make sure to adhere to accident prevention rules given in SNiP 12-04-2002 "Labour safety in construction", Part 2.

While cleaning surfaces with acid, take utmost care to use safety goggles, rubber gloves and special cloths made of dense fabric.

Mixing and application of slurries shall be made in rubber gloves and safety goggles, avoid contacts with eyes and skin; in case of inadvertent contact, immediately wash by water.

During hydraulic waterproofing, take care to avoid impacts of the following dangerous and noxious production factors associated with the nature of works being completed:

- Excessive dust and gas content in air of working zone;

- High or low temperature of equipment surfaces, materials and air in working zone;

- Workstation location adjacent to altitude differential for more than 1.3 m or higher;

- Sharp edges, scale and roughness on the surface of equipment and materials.

If above dangerous and noxious production factors are available, safety of hydraulic waterproofing shall be provided based on adherence to the following labour protection decisions given in organisational and production documents:

- Layout of workstations with statement of methods and facilities to ensure ventilation, fire-fighting, protection against thermal and chemical burns, lighting and high-altitude operations;

- Special safety precautions during works in confined spaces, plants and vessels.

Workstations for hydraulic waterproofing at high altitude must be equipped with working platforms, equipped hand rails and ladders for lifting in conformity to requirements SNiP 12-03-2002 "Labour safety in construction", Part 1.

Annex 1

TECHNICAL CHARACTERISTICS OF PENETRON SYSTEM MATERIALS

"Penetron"

SL No.	Indicator	Value	Method of measurement
1	Visual appearance	Loose powder, grey colour, without lumps and mechanical admixtures	TU 5745-001-77921756-2006
2	Moisture content by mass, % max.	0.6	TU 5745-001-77921756-2006
3	Setting time, min. start, not earlier, completion, not later	 40 90	TU 5745-001-77921756-2006
4	Filling density in standard loose state, kg/m^3	1,200±50	TU 5745-001-77921756-2006
5	Upgrade of concrete brand in terms of waterproofness after treatment, steps, at least	4	TU 5745-001-77921756-2006
6	Upgrade of pre-treated concrete compression strength vs primary strength, %, at least	10.0	TU 5745-001-77921756-2006
7	Concrete post-treatment resistance, cycles, at least	100	GOST 10060.0-95
8	Concrete post-treatment resistance to acid solutions, namely HCl, H_2SO_4	resistant	St. SEV 5852-86
9	Concrete post-treatment resistance to alkali, namely NaOH	resistant	St. SEV 5852-86
10	Concrete post-treatment resistance to light and dark petroleum products	resistant	St. SEV 5852-86
11	Concrete post-treatment resistance to gamma radiation, dose 3,000 Mrad	resistant	Conclusion PTO Progress No. 22/26 dated 06.05.03
12	Ultraviolet	has no effects	St. SEV 5852-86
13	Applicability for potable water vessels	allowed	TU 5745-001-77921756-2006

14	Acidity of application medium, pH	3 to 11	St. SEV 5852-86
15	Use: surface temperature, °C, at least	+5	TU 5745-001-77921756-2006
16	Operating temperature, °C	-60 to +130	TU 5745-001-77921756-2006
17	Material storage conditions	Inside premises of any humidity at temperature -80 to +80°C	TU 5745-001-77921756-2006
18	Warranty shelf life, months, at least	18	TU 5745-001-77921756-2006

"Penecrete"

SL No.	Indicator	Value	Method of measurement
1	Visual appearance	Loose powder, grey colour, without lumps and mechanical admixtures	TU 5745-001-77921756-2006
2	Moisture content by mass, % max.	0.6	TU 5745-001-77921756-2006
3	Setting time, min. start, not earlier, completion, not later	 40 90	TU 5745-001-77921756-2006
4	Filling density in standard loose state, kg/m^3	1,300±50	TU 5745-001-77921756-2006
5	Cohesion strength with concrete, MPa, at least	2.0	TU 5745-001-77921756-2006
6	Material compression strength, at least, MPa In 7 days In 28 days	 20.0 25.0	TU 5745-001-77921756-2006
7	Type by waterproofness of material, W, at least	14	TU 5745-001-77921756-2006
8	Type by frost resistance of material, cycles, at least	F400	GOST 10060.0-95
9	Ultraviolet	has no effects	St. SEV 5852-86
10	Applicability for potable water vessels	allowed	TU 5745-001-77921756-2006
11	Use: surface temperature, °C, at least	+5	TU 5745-001-77921756-2006
12	Temperature of surface performance, °C, at least	-60 to +130°C	TU 5745-001-77921756-2006
13	Material storage conditions	Inside premises of any humidity at temperature -80 to +80°C	TU 5745-001-77921756-2006
14	Warranty shelf life, months, at least	18	TU 5745-001-77921756-2006

"Penecrete"

SL No.	Indicator	Value	Method of measurement
1	Visual appearance	Loose powder, grey colour, without lumps and mechanical admixtures	TU 5745-001-77921756-2006
2	Moisture content by mass, % max.	0.6	TU 5745-001-77921756-2006
3	Setting time, min. start, not earlier, completion, not later	 1 4	TU 5745-001-77921756-2006
4	Filling density in standard loose state, kg/m^3	1,100±50	TU 5745-001-77921756-2006
5	Cohesion strength with concrete, MPa, at least	2.0	TU 5745-001-77921756-2006
6	Type by waterproofness of material, W, at least	16	TU 5745-001-77921756-2006
7	Material compression strength, at least, MPa In 24 hours In 7 days In 28 days	 6.0 14.0 17.0	TU 5745-001-77921756-2006
8	Type by frost resistance of material, cycles, at least	F300	GOST 10060.0-95
9	Ultraviolet	has no effects	St. SEV 5852-86
10	Use: surface temperature, °C, at least	+5	TU 5745-001-77921756-2006
11	Temperature of surface performance, °C, at least	-60 to +130°C	TU 5745-001-77921756-2006
12	Material storage conditions	Inside premises of any humidity at temperature -80 to +80°C	TU 5745-001-77921756-2006
13	Warranty shelf life, months, at least	18	TU 5745-001-77921756-2006

"Penecrete"

SL No.	Indicator	Value	Method of measurement
1	Visual appearance	Loose powder, grey colour, without lumps and mechanical admixtures	TU 5745-001-77921756-2006
2	Moisture content by mass, % max.	0.6	TU 5745-001-77921756-2006
3	Setting time, min. start, not earlier, completion, not later	 2 5	TU 5745-001-77921756-2006
4	Filling density in standard loose state, kg/m^3	1,200±50	TU 5745-001-77921756-2006
5	Type by waterproofness of material, W, at least	14	TU 5745-001-77921756-2006
6	Material compression strength, at least, MPa In 24 hours In 7 days In 28 days	 10.0 14.0 16.0	GOST 10180-90
7	Type by frost resistance of material, cycles, at least	F200	GOST 10060.0-95
8	Ultraviolet	has no effects	St. SEV 5852-86
9	Use: surface temperature, °C, at least	+5	TU 5745-001-77921756-2006
10	Temperature of surface performance, °C, at least	-60 to +130°C	TU 5745-001-77921756-2006
11	Material storage conditions	Inside premises of any humidity at temperature -80 to +80°C	TU 5745-001-77921756-2006
12	Warranty shelf life, months, at least	18	TU 5745-001-77921756-2006

"Penecrete"

SL No.	Indicator	Value	Method of measurement
1	Visual appearance	Loose powder, grey colour, without lumps and mechanical admixtures	TU 5745-001-77921756-2006
2	Moisture content by mass, % max.	0.6	TU 5745-001-77921756-2006
3	Upgrade of concrete brand in terms of waterproofness, concrete with additive, steps, at least	3	TU 5745-001-77921756-2006
4	Upgrade of Concrete post-treatment compression strength vs primary strength, %, at least	10.0	TU 5745-001-77921756-2006
5	Filling density in standard loose state, kg/m^3	1,100±50	TU 5745-001-77921756-2006
6	Upgrade of frost resistance, concrete with additive, cycles, at least	100	GOST 10060.0-95
7	Concrete post-treatment resistance to acid solutions, namely HCl, H_2SO_4	resistant	St. SEV 5852-86
8	Concrete post-treatment resistance to alkali NaOH	resistant	St. SEV 5852-86
9	Concrete post-treatment resistance to light and dark petroleum products	resistant	St. SEV 5852-86
10	Ultraviolet	has no effects	St. SEV 5852-86
11	Applicability for potable water vessels	allowed	TU 5745-001-77921756-2006
12	Acidity of application medium, pH	3 to 11	St. SEV 5852-86
13	Operating temperature, °C	-60 to +130	TU 5745-001-77921756-2006
14	Material storage conditions	Inside premises of any humidity at temperature -80 to +80°C	TU 5745-001-77921756-2006
15	Warranty shelf life, months, at least	18	TU 5745-001-77921756-2006

"Penecrete"

SL No.	Indicator	Value	Method of measurement
1	Density, g/cm^3, max.	1.5	TU 5772-001-7791983-2006
2	Volumetric expansion (storage in water), %, max. - 24 hours - 7 days - 14 days	 140 200 300	TU 5772-001-77919831-2006
3	Uniformity	Uniform mass with inclusions up to 0.35 mm	TU 5772-001-77919831-2006
4	Ultimate tensile strength, MPa, at least	0.15	TU 5772-001-77919831-2006
5	Relative elongation at maximum load, %, at least	700	TU 5772-001-77919831-2006
6	Water absorption, %, at least	50	St. SEV 5852-86
7	Resistance to acid solutions, namely HCl, H_2SO_4	resistant	St. SEV 5852-86
8	Resistance to alkali NaOH	resistant	St. SEV 5852-86
9	Resistance to light and dark petroleum products	resistant	St. SEV 5852-86
10	Ultraviolet	has no effects	St. SEV 5852-86
11	Acidity of application medium, pH	3 to 11	St. SEV 5852-86
12	Use: surface and air temperature, °C	-22 to +50	TU 5772-001-77919831-2006
13	Operating temperature, °C	-60 to +100	TU 5772-001-77919831-2006
14	Material storage conditions	Inside premises of any humidity at temperature -60 to +50°C	TU 5772-001-77919831-2006
15	Warranty shelf life, months, at least	18	TU 5772-001-77919831-2006

Annex 2

CHEMICAL RESISTANCE AND CORROSION RESISTANCE CONCRETE PROPERTIES AFTER PROCESSING BY PENETRON SYSTEM MATERIALS

Terminology		**+ no destructive medium effect +/- negligible medium effect - medium effect available**	
No.	***Corrosive medium***	***Effect on untreated concrete***	***After treatment with Penetron system***
1	Nitric acid 2%-40%	Destructive effect	-
2	Alumocalcite alum	Destruction in case of insufficient concrete resistance to sulphate effects	+
3	Animal fat (mutton fat, pork fat, etc.)	In solid state: slow destructive effect; in liquid (melted) state: intensification of destruction processes	+
4	Ammonium bisulphate	Destructive effect. Negative effect on rebars through pores and cracks in concrete	+
5	Sodium bisulphate	Destructive effect	+/-
6	Potassium bichromate	Destructive effect	+
7	Boric acid	Low destructive effect	+
8	Bromides or bromates	Destructive effect of vapours. Destructive effects from solutions of bromides containing hydrobromic acid	+
9	Brown coal oil	Low destructive effect	+
10	Glycerol tristearate butyne	Low destructive effect	+
11	Exhaust gases	Probable destruction of fresh concrete under effect of nitrites, carbonates, caustic acids	+
12	Carbonated water (CO_2)	Low destructive effect	+
13	Potassium hydroxide 25%-95%	Destructive effect	+/-
14	Sodium hydroxide, 20%-40%	Destructive effect	+/-
15	Glycerol	Low destructive effect	+
16	Glucose	Low destructive effect	+

No.	*Corrosive medium*	*Effect on untreated concrete*	*After treatment with Penetron system*
17	Humic acid	Low destructive effect	+
18	Tannic acid	Low destructive effect	+
19	Tannic juice	Destructive effect	+
20	Flue gases	Thermal destruction under effect of hot gases (100-400°C). Low destructive effect by chilled gases containing sulphate and chloride compounds	+
21	Liquid ammonia	Destructive effect in presence of ammonia salts	+
22	Ash/cinder	Harmful effects in wet condition, when sulphide and sulphate solutions are formed	+
23	Iodine	Low destructive effect	+
24	Sodium carbonate	Destructive effect	+
25	Castor oil	Destructive effect	+
26	Alum	See alumocalcite alum	+
27	Cresylic acid	Low destructive effect with available phenol	+
28	Engine oil	Low destructive effect with available fatty oils	+
29	Almond oil	Low destructive effect	+
30	Lactic acid 25%	Low destructive effect	+
31	Seawater	Destructive effect on concrete with insufficient resistance to sulphates, negative effects on rebars through pores and cracks in concrete	+
32	Formic acid (10-90%)	Low destructive effect	+/-
33	Ammonia nitrate	Destructive effect on concrete with insufficient resistance to sulphates, negative effects on rebars through pores and cracks in concrete	+/-
34	Magnesium nitrate	Low destructive effect	+
35	Sodium nitrate	Low destructive effect	+
36	Vegetables	Low destructive effect	+
37	Olive oil	Low destructive effect	+
38	Slaughter house wastes	Destructive effect from organic acids	+

No.	*Corrosive medium*	*Effect on untreated concrete*	*After treatment with Penetron system*
39	Ammonia vapours	May initiate destruction of fresh concrete or impact metal through pores of fresh concrete	+
40	Brine	Negative effects on rebars through pores and cracks in concrete	+
41	Sulphuric acid up to 10%	Strong destructive effects	+
42	Sulphuric acid 10%-93%	Strong destructive effects	-
43	Sulphurous acid	Strong destructive effects	-
44	Hydrogen sulphide	Forms sulphuric acid while interacting with water and thionine bacteria, which initiates concrete destruction	+/-
45	Silo	Strong destructive effect from acetic, oil and lactic acid, less often in presence of acid ferments	+
46	Lube oil	Low destructive effect in presence of fatty oils	+
47	Hydrochloric acid 10%	Strong destructive effects, negative effects on rebars	+
48	Hydrochloric acid 30%	Strong destructive effects, negative effects on rebars	+/-
49	Waste water	Destructive effects	+
50	Cobalt sulphate	Destructive effects in case of insufficient concrete resistance to sulphates	+
51	Aluminium sulphate over 5%	Strong destructive effects, negative effects on rebars through pores and cracks in concrete	+/-
52	Aluminium sulphate below 5%	Strong destructive effects, negative effects on rebars through pores and cracks in concrete	+
53	Ammonia sulphate	Strong destructive effects, negative effects on rebars through pores and cracks in concrete	+/-
54	Iron sulphate II	Destructive effects in case of insufficient concrete resistance to sulphates	+
55	Iron sulphate III	Destructive effects	+
56	Calcium sulphate	Destructive effects in case of insufficient concrete resistance to sulphates	+
57	Magnesium sulphate	Destructive effects in case of insufficient concrete resistance to sulphates	+

No.	*Corrosive medium*	*Effect on untreated concrete*	*After treatment with Penetron system*
58	Copper sulphate	Destructive effects in case of insufficient concrete resistance to sulphates	+
59	Sodium sulphate	Destructive effects	+
60	Nickel sulphate	Destructive effects in case of insufficient concrete resistance to sulphates	+
61	Ammonia sulphide	Destructive effects	+/-
62	Sodium sulphide	Destructive effects in case of insufficient concrete resistance to copper sulphates	+
63	Sodium sulphide	Destructive effects	+
64	Ammonia sulphite	Destructive effects	+/-
65	Sodium sulphite	Destructive effects with available sodium sulphate	+
66	Ammonia superphosphate	Destructive effects, negative effects on rebars through pores and cracks in concrete	+/-
67	Ammonia thiosulfate	Destructive effects	+/-
68	Coal	Sulphides emitting from coal may oxidise to sulphuric acid or ferrous sulphate	+
69	Acetic acid up to 30%	Low destructive effects	+/-
70	Phenol	Low destructive effects	+
71	Formaldehyde solution	See formaldehyde	
72	Formaldehyde (37%)	Low destructive effects from formic acid forming in solution	+/-
73	Sodium phosphate (monobasic)	Low destructive effects	+
74	Phosphoric acid 10%	Low destructive effects	+
75	Phosphoric acid 85%	Low destructive effects	+/-
76	Fruit juices	Destructive effect is caused by acids and sugar	+
77	Ammonia fluoride	Low destructive effects	+
78	Hydrofluoric acid 10%	Strong destructive effects, destruction of rebars	+/-
79	Hydrofluoric acid 75%	Strong destructive effects	-

No.	*Corrosive medium*	*Effect on untreated concrete*	*After treatment with Penetron system*
80	Chlorine	Low destructive effect on wet concrete	+
81	Ammonia chloride	Low destructive effects, negative effects on rebars	+
82	Potassium chloride	With available magnesium chloride – negative effects on rebars through pores and cracks in concrete	+
83	Calcium chloride	Effects on rebars through pores and cracks in concrete. Corrosion of rebars may cause local concrete destruction	+
84	Magnesium chloride	Low destructive effects, negative effects on rebars	+
85	Copper chloride	Low destructive effects	+
86	Sodium chloride	Effects on concrete and rebars through pores and cracks	+
87	Chlorinated water	See special chemicals: Hyperchlorous acid, soda hypochlorite, etc.	
88	Chlorine mercury I	Low destructive effects	+
89	Chlorine mercury II	Low destructive effects	+
90	Hyperchlorous acid 10%	Low destructive effects	+
91	Chromic acid (5% to 60%)	Effects on rebars through pores and cracks in concrete	+
92	Chromium-based solutions	Low destructive effects	+
93	Ammonia cyanide	Low destructive effects	+
94	Sodium cyanide	Low destructive effects	+
95	Potassium cyanide	Low destructive effects	+
96	Shaft water, wastes	Destructive effects from sulphides, sulphates, acids. Negative effects on rebars through cracks and pores in concrete	-
97	Slag	Harmful in wet condition, when sulphides and sulphates are formed	+
98	Ethylene glycol	Low destructive effects	+

Annex 3

RECOMMENDED EQUIPMENT, TOOLS, INDIVIDUAL PROTECTION GEARS

1. Equipment:

- High-pressure water jet plant (voltage 220 V; power 3,100 W; pressure 20-150 bar;
- High-pressure water jet plant (voltage 380 V; power 8,400 W; pressure 20-230 bar;
- Pneumatic pick (voltage 220 V; power 1,050 W; frequency 900-2,000 strikes/min);
- Pneumatic drill (voltage 220 V; power 1,000 W; frequency 900-2,000 strike/min);
- Low-speed drill (voltage 220 V; power from 1,000 W; frequency 250-500 rpm);
- Tooth cutter (voltage 220 V; power 2,200 W; frequency 6,000-10,000 rpm);
- Angle grinder (voltage 220 V; power 1,200 W; frequency 11,000 rpm);
- Industrial grade vacuum cleaner (voltage 220 V; power 1,100 W);
- Drain pump (voltage 220 V; power from 2,100 W);
- Drain pump (voltage 380 V; power 6,000-8,000 W);
- Gravitational concrete mixer (voltage 220 V (380 V); power 1,100 W – 2,200 W);
- Auger slurry pump (voltage 380 V; power 1,900 W; maximum feed pressure 2.0 MPa);
- Compressor (voltage 380 V; power 2,200 W; capacity 250 l/min).

2. Tools:

- Synthetic fleece brush;
- Metal wire brush (for manual and mechanical use);
- Metal spatula;
- Pan (bucket) capacity 5-7 l, soft plastic;
- Hammer;
- Chisel;
- Float;
- Trowel;
- Scoop;
- Spring balance;

- Metering vessel for water;
- Diamond wheel for reinforced concrete;
- Chisel for pneumatic pick;

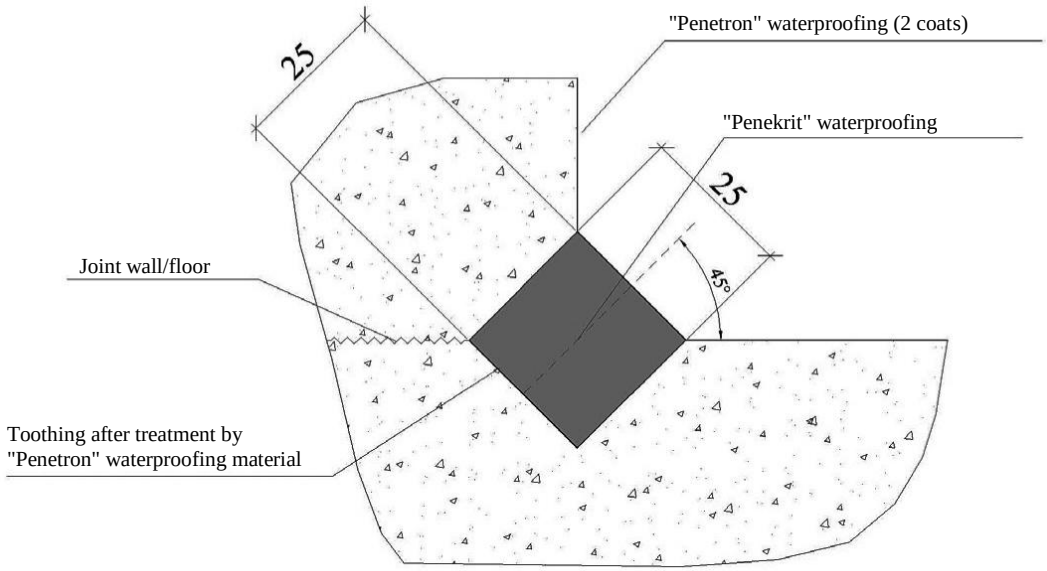
3. Individual protection gears:

- Rubber gloves, chemically resistant;
- Cotton gloves;
- Respirator;
- Safety goggles;
- Special coveralls, dense fabric;
- Rubber high boots.

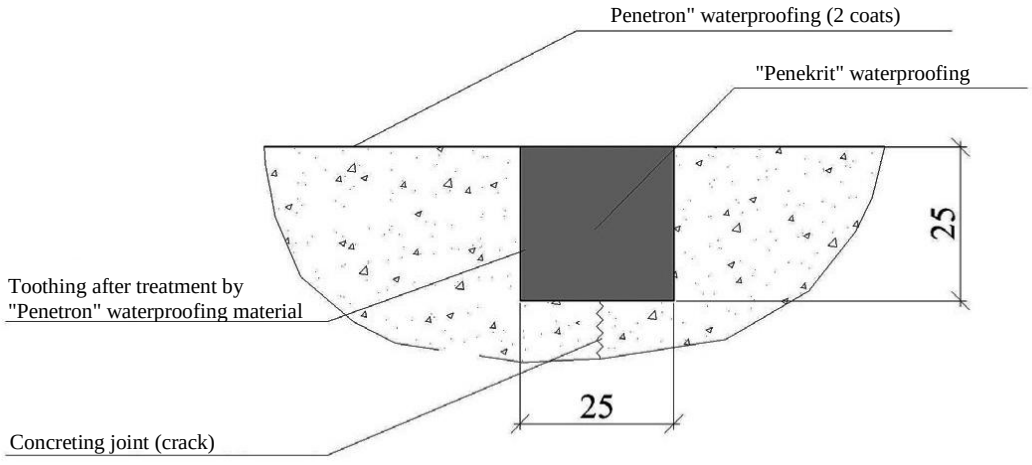
Annex 4

Typical assemblies

Adjoining assembly wall/floor



Repair of concreting joints and cracks



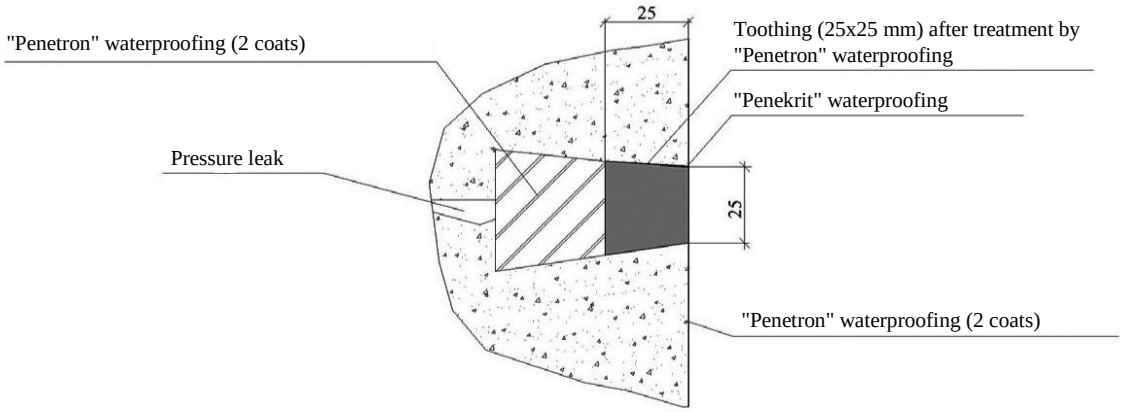
						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Typical assemblies with application of "Penetron" system waterproofing materials
Prepared by						
Checked by						

STAGE	SHEET	TOTAL

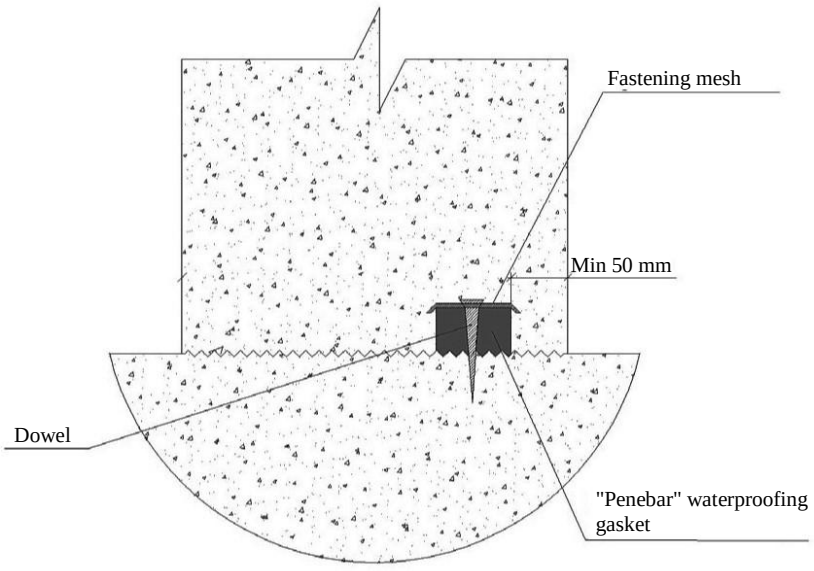
SRO RSPPPG

Typical assemblies

Pressure leak elimination



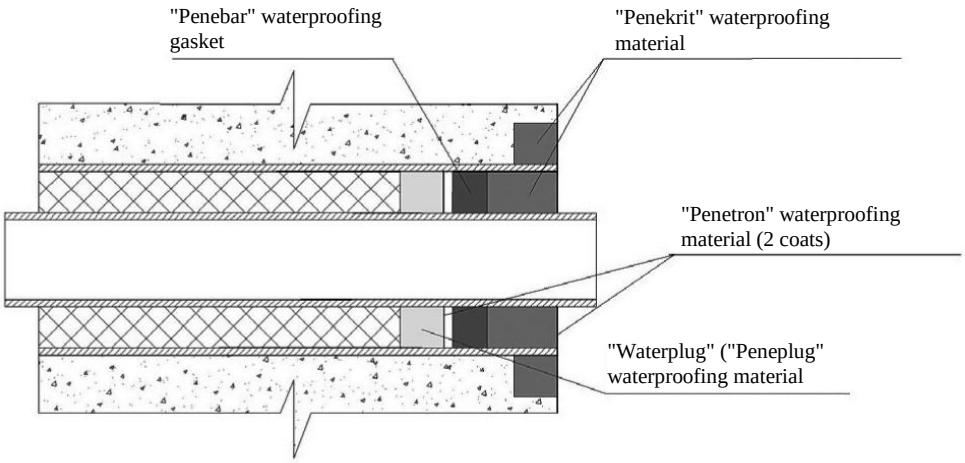
Adjoining assembly during construction



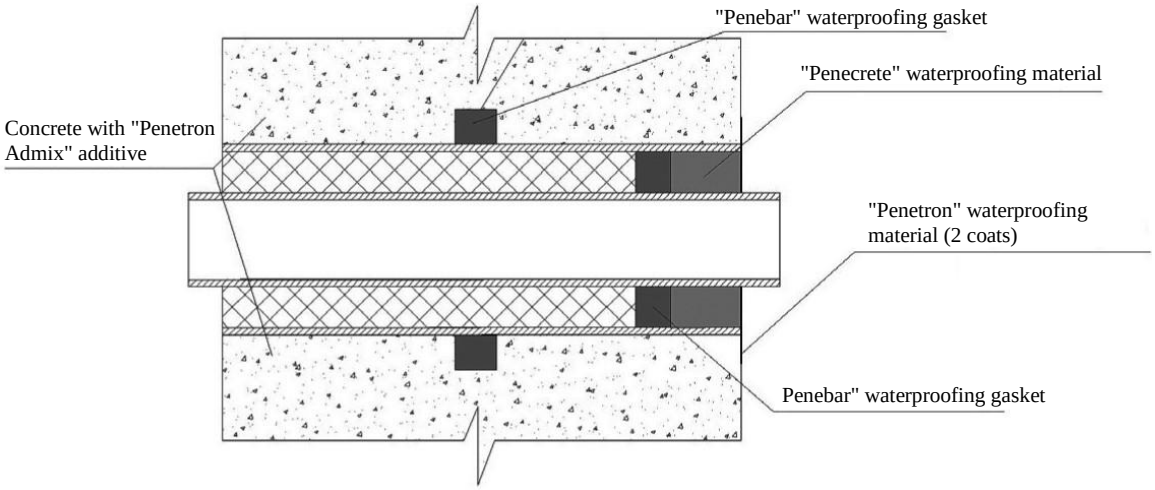
						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
							STAGE	SHEET	TOTAL
Director						Typical assemblies			
Chief Project Engineer									
Team leader						Typical assemblies with application of "Penetron" system waterproofing materials	SRO RSPPPG		
Prepared by									
Checked by									

Service inlet

a) existing structures

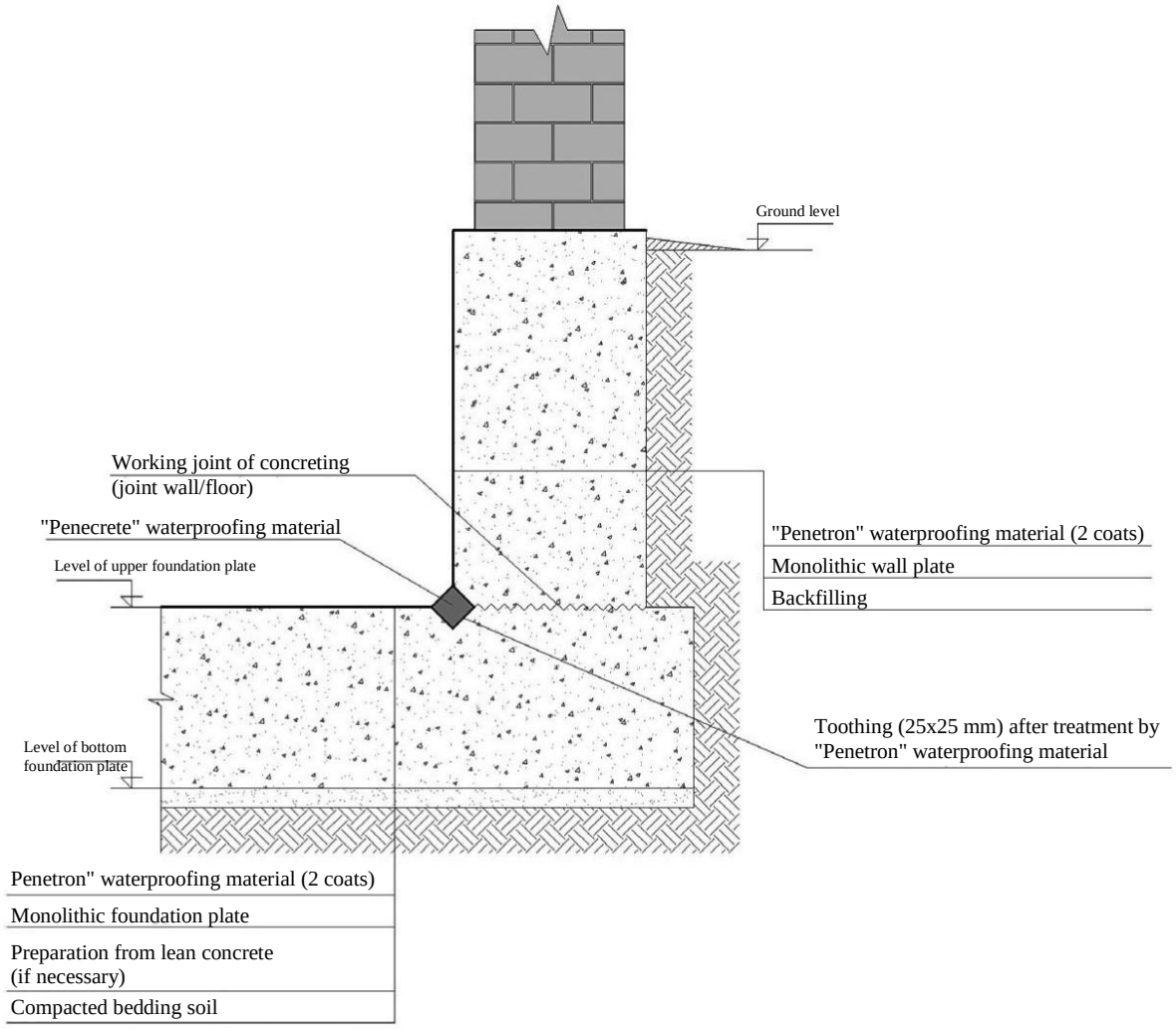


b) structure under construction



						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Typical assemblies with application of "Penetron" system waterproofing materials	SRO RSPPPG		
Prepared by									
Checked by									

Variant 1

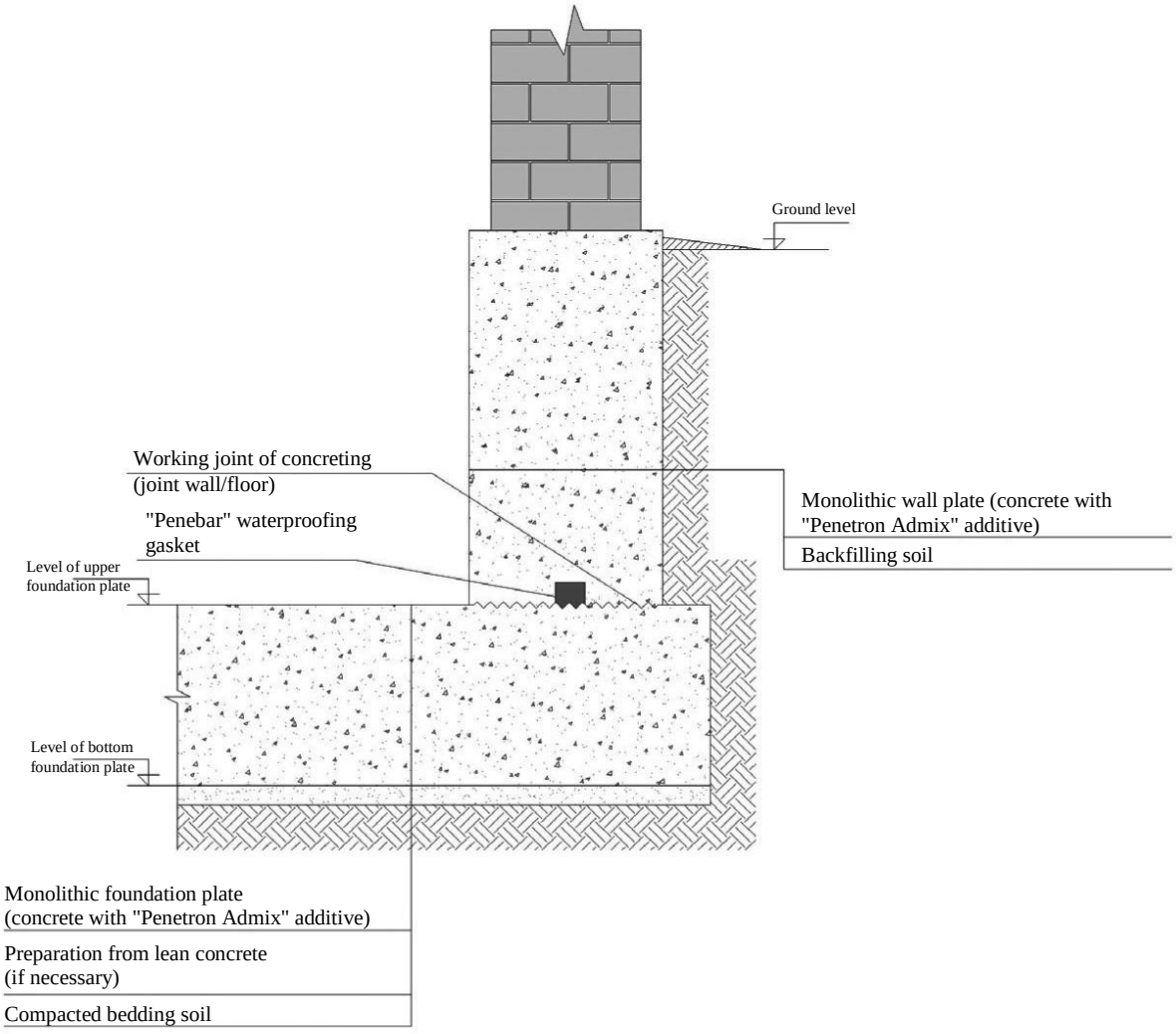


						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Plugging of capillary suction between concrete foundation and wall made of porous materials
Prepared by						
Checked by						

STAGE	SHEET	TOTAL

SRO RSPPPG

Variant 2



Notes to variant 2:

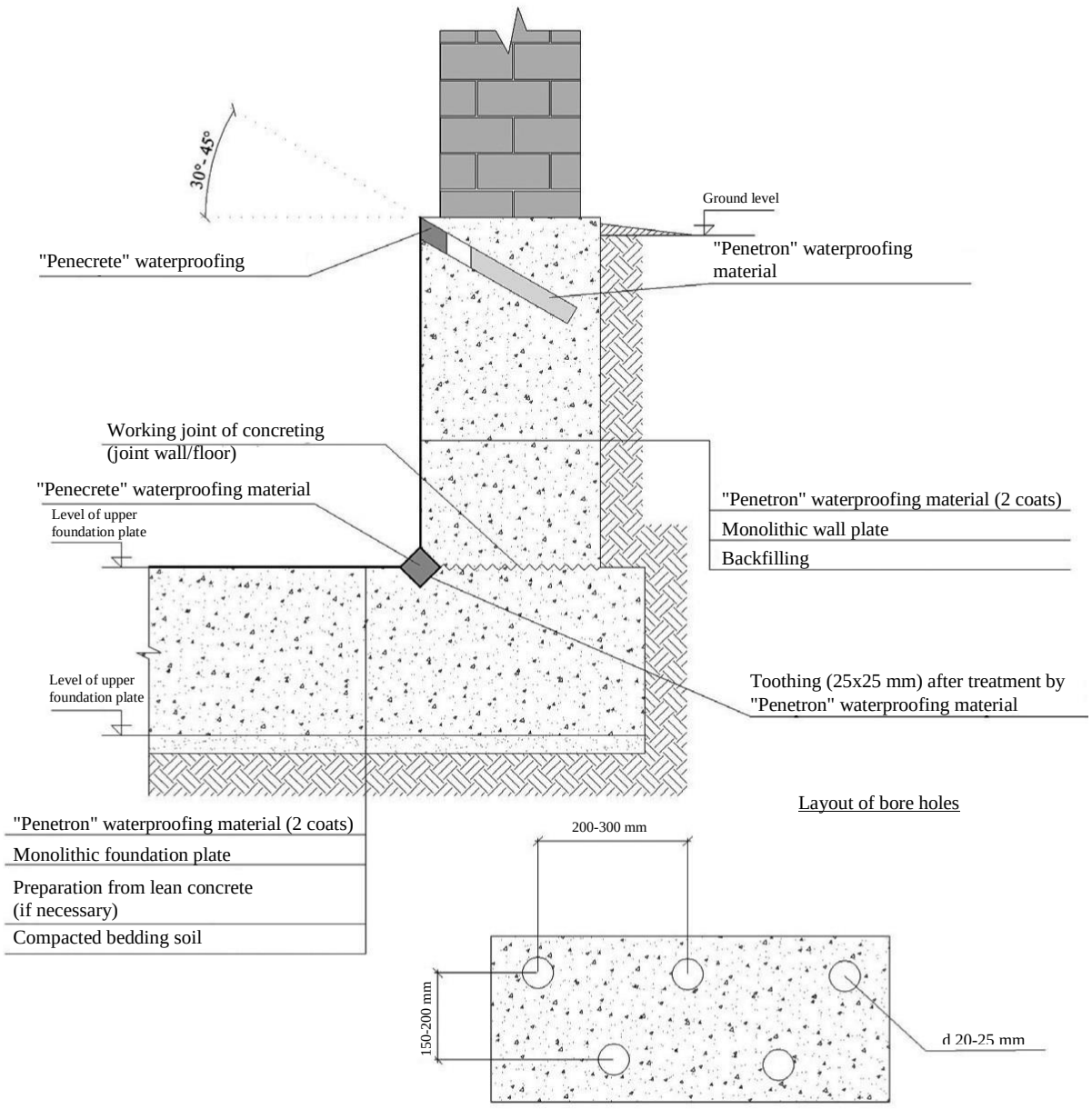
During concreting, make sure to use concrete of design strength with "Penetron Admix" additive 1% of cement mass

						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Plugging of capillary suction between concrete foundation and wall made of porous materials
Prepared by						
Checked by						

STAGE	SHEET	TOTAL

SRO RSPPPG

Variant 3



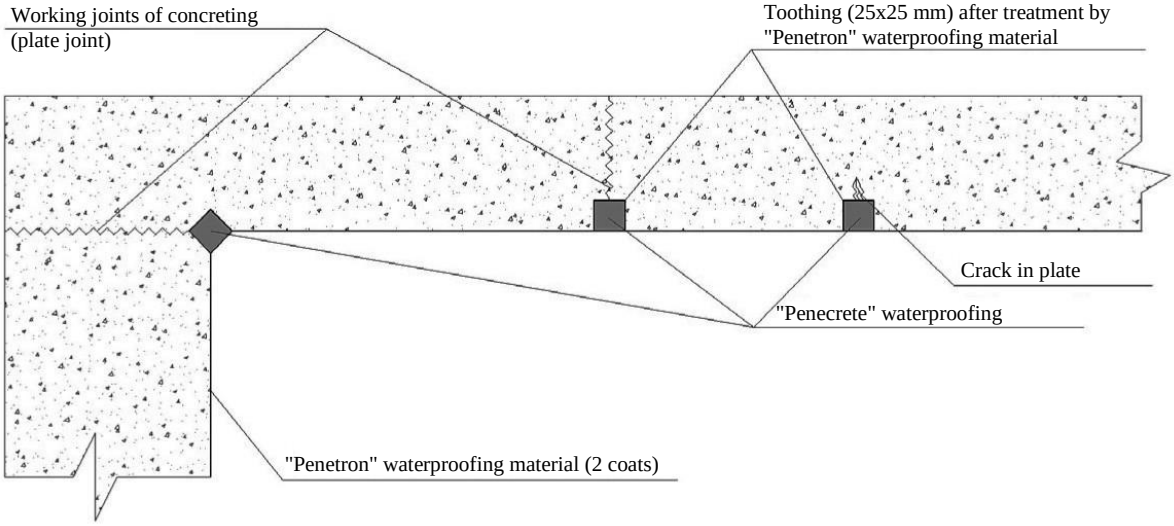
						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Plugging of capillary suction between concrete foundation and wall made of porous materials
Prepared by						
Checked by						

STAGE	SHEET	TOTAL

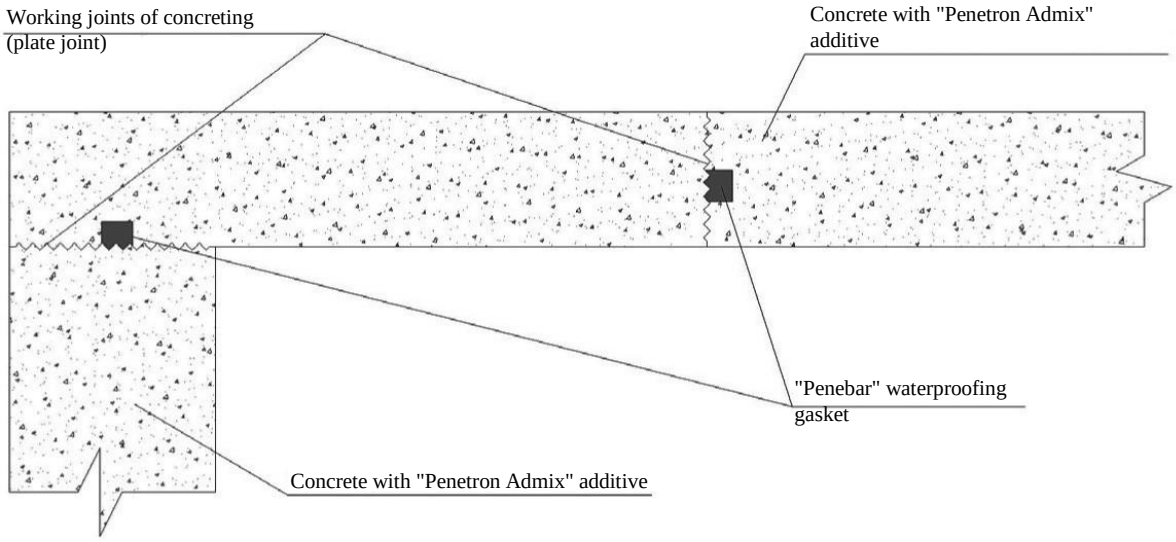
SRO RSPPPG

Monolithic bays

Existing structure



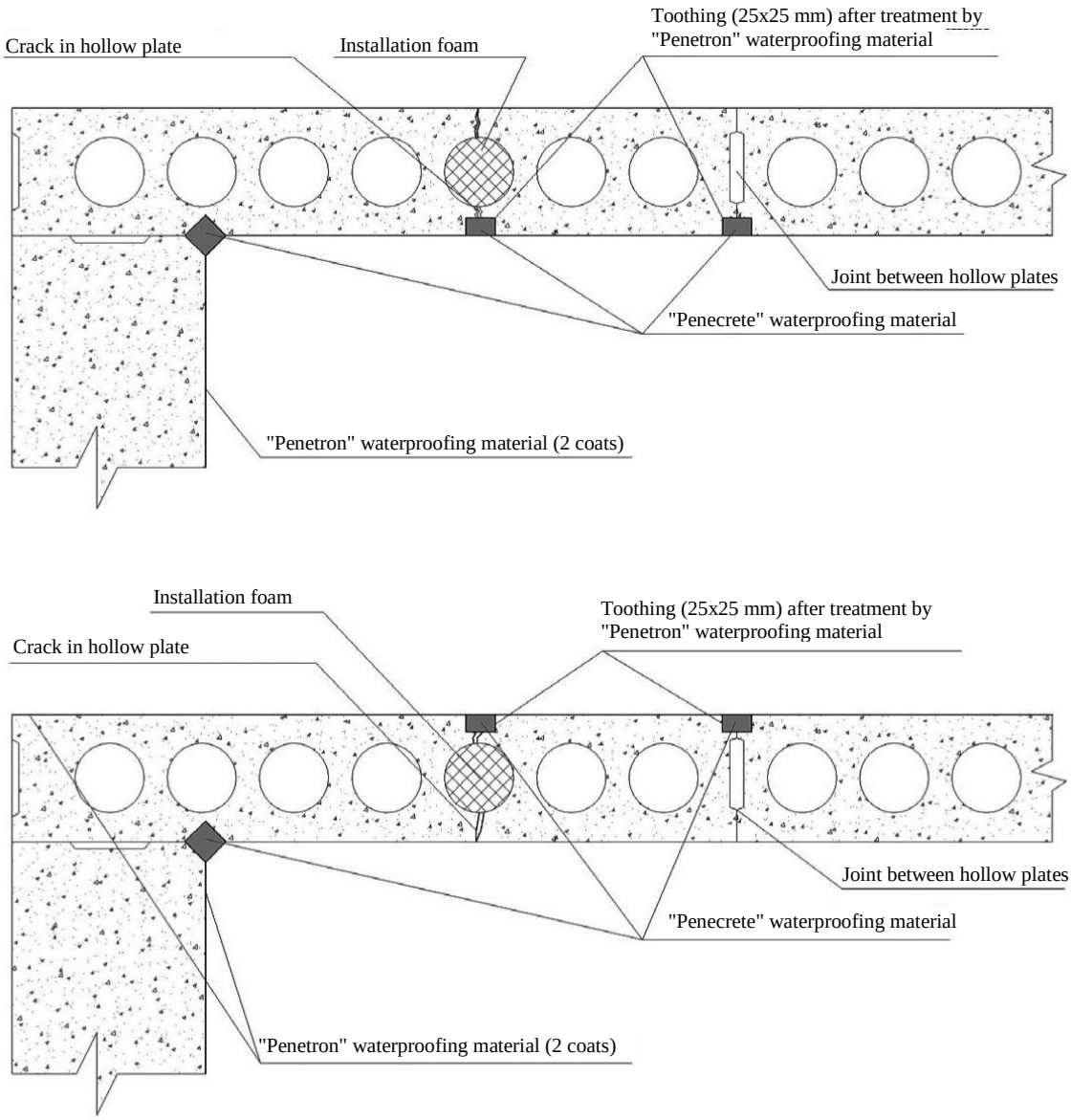
Structure under construction



Note to variant "Structure under construction":
During concreting, make sure to use concrete of design strength with "Penetron Admix" additive 1% of cement mass

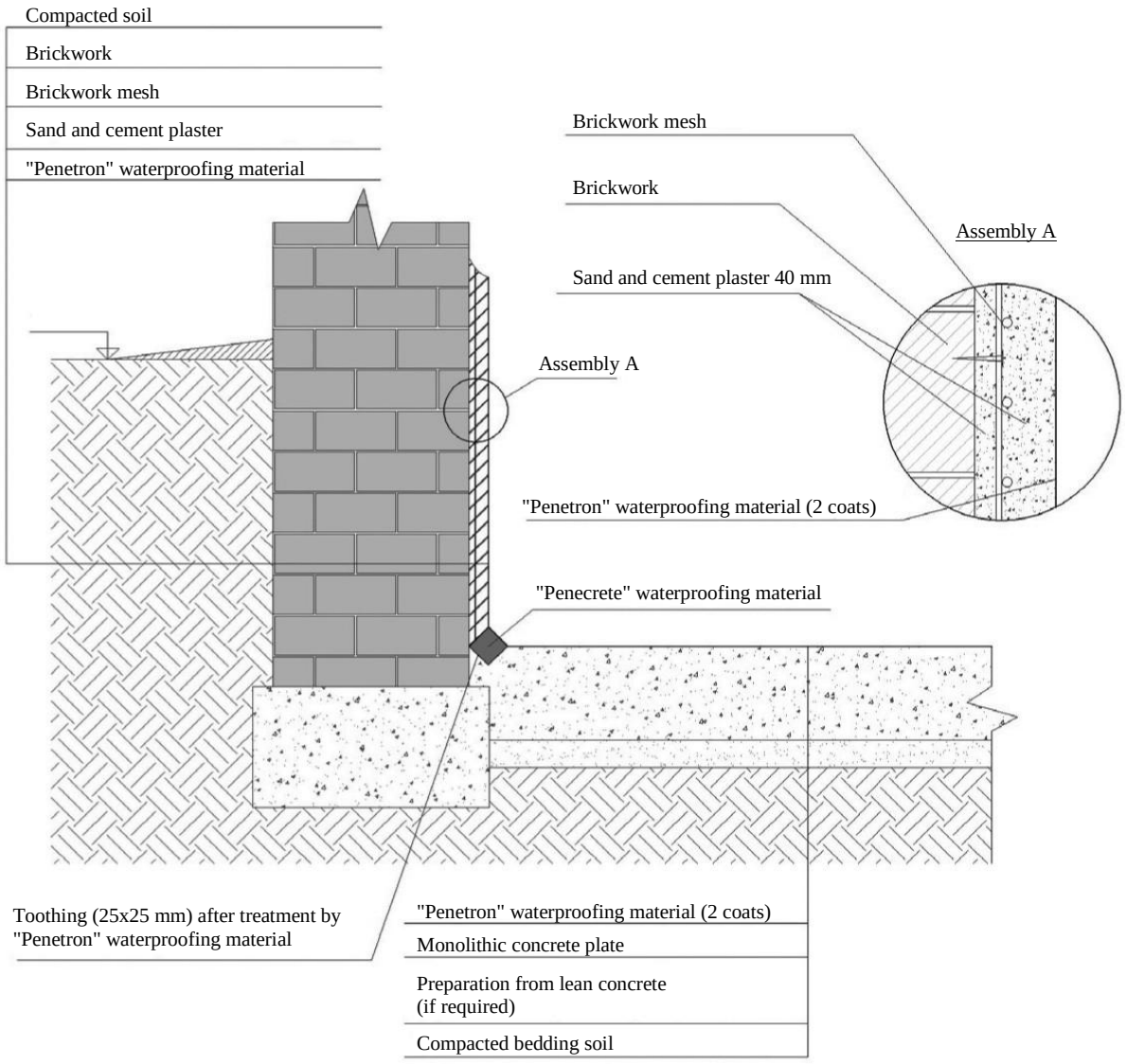
						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Monolitic bays	SRO RSPPPG		
Prepared by									
Checked by									

Hollow plate bay



						SRO RSPPPG		
Rev.	Qty	Sheet	Doc. No.	Signature	Date			
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Hollow plate bay	SRO RSPPPG		
Prepared by									
Checked by									

Internal waterproofing on brick wall

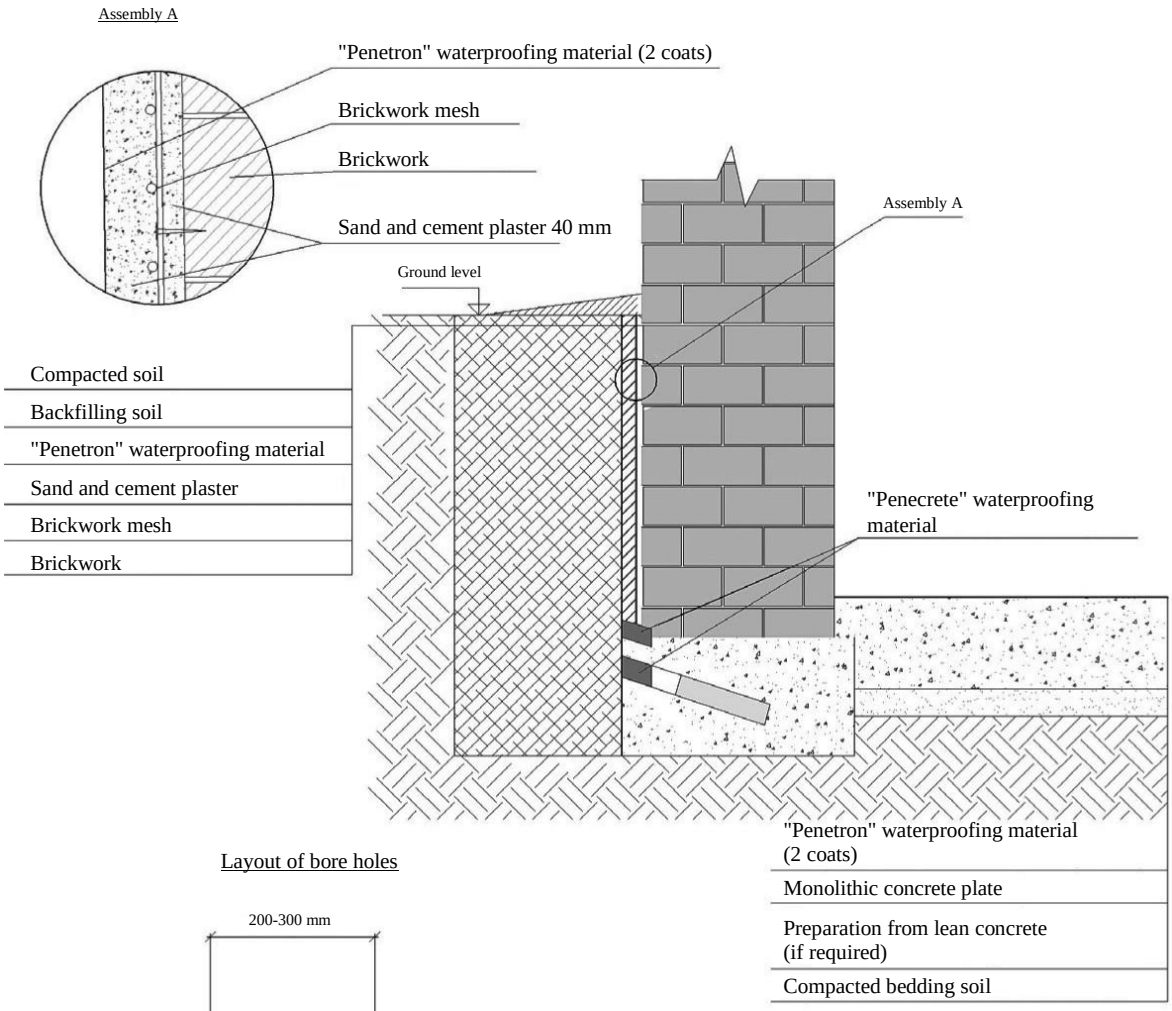


						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Internal waterproofing on brick wall
Prepared by						
Checked by						

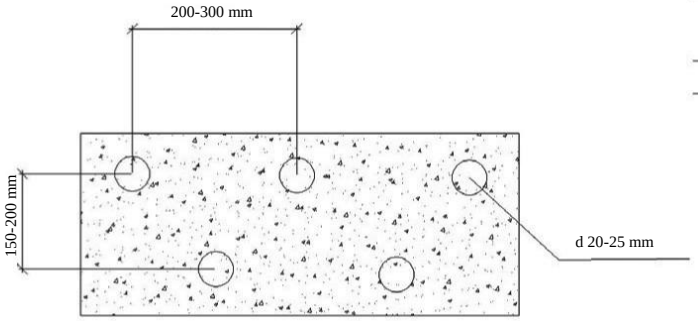
STAGE	SHEET	TOTAL

SRO RSPPPG

Outer waterproofing on brick wall



Layout of bore holes

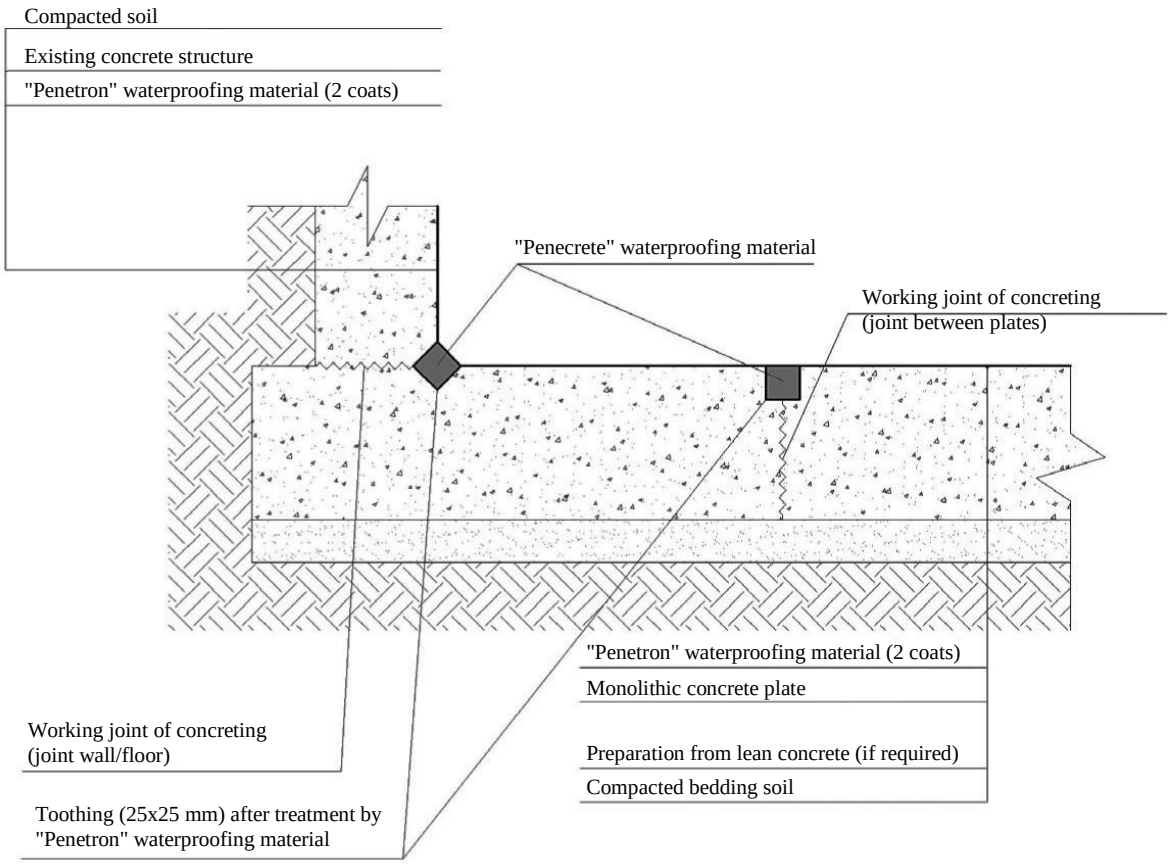


						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Outer waterproofing on brick wall
Prepared by						
Checked by						

STAGE	SHEET	TOTAL

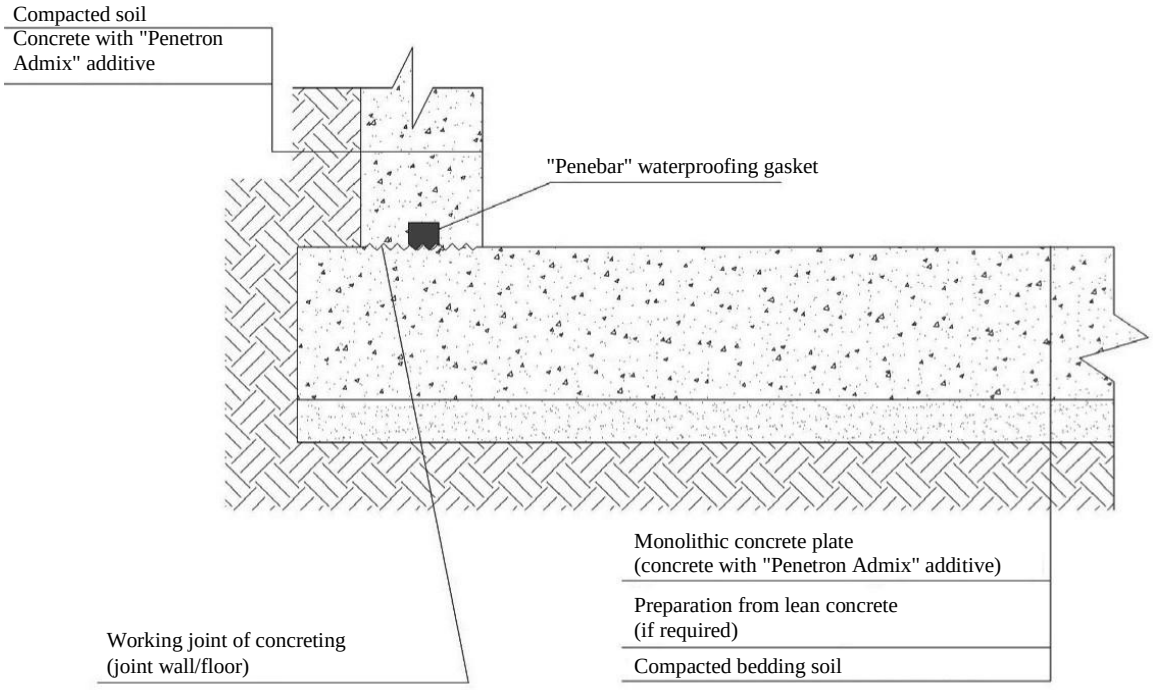
SRO RSPPPG

Existing structure



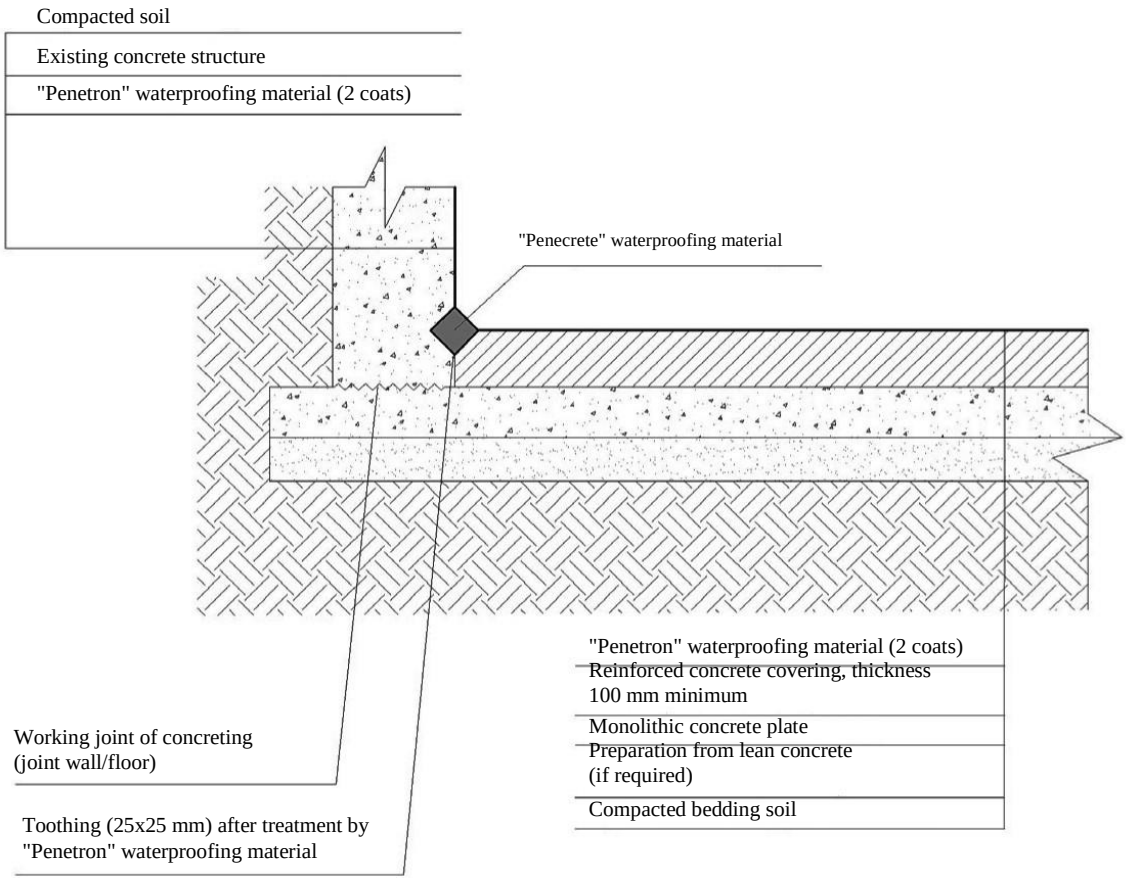
						SRO RSPPPG	
Rev.	Qty	Sheet	Doc. No.	Signature	Date		
						STAGE	SHEET	TOTAL
Director						Typical assemblies		
Chief Project Engineer								
Team leader						Typical assemblies with application of "Penetron" system waterproofing materials	SRO RSPPPG	
Prepared by								
Checked by								

Structure under construction



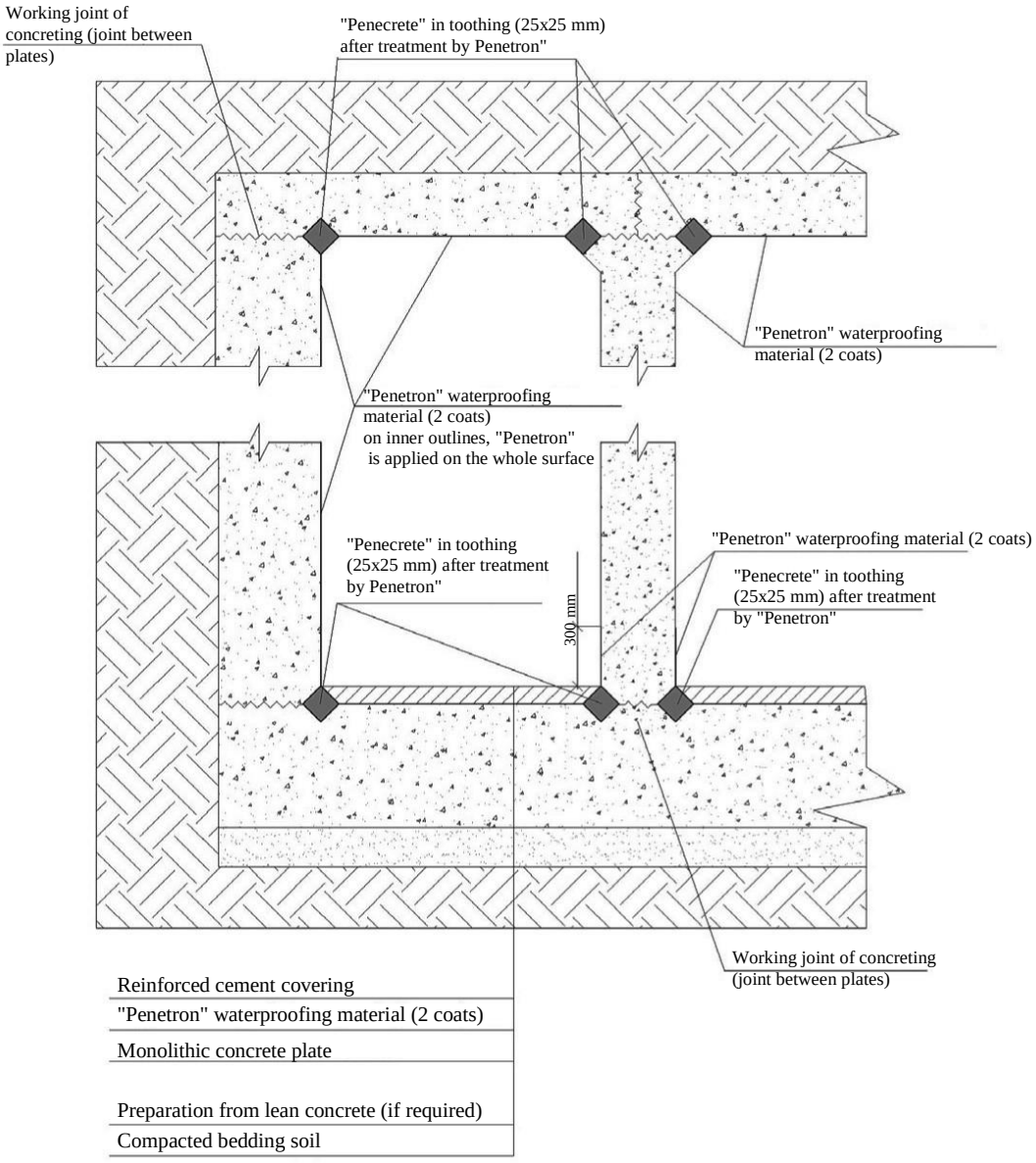
						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Typical assemblies with application of "Penetron" system waterproofing materials	SRO RSPPPG		
Prepared by									
Checked by									

Arrangement of waterproofing over reinforced concrete covering



						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Typical assemblies with application of "Penetron" system waterproofing materials	SRO RSPPPG		
Prepared by									
Checked by									

Monolithic structure
(existing)

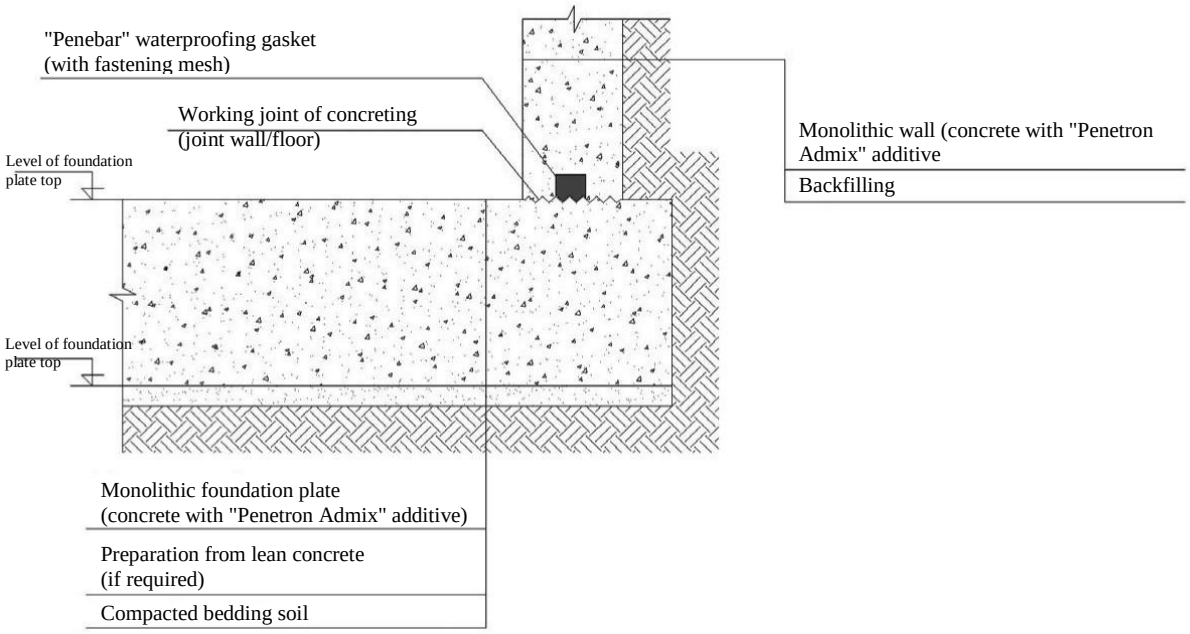


						SRO RSPPPG
Rev.	Qty	Sheet	Doc. No.	Signature	Date	
						Typical assemblies
Director						
Chief Project Engineer						
Team leader						Monolithic structure (existing)
Prepared by						
Checked by						

STAGE	SHEET	TOTAL

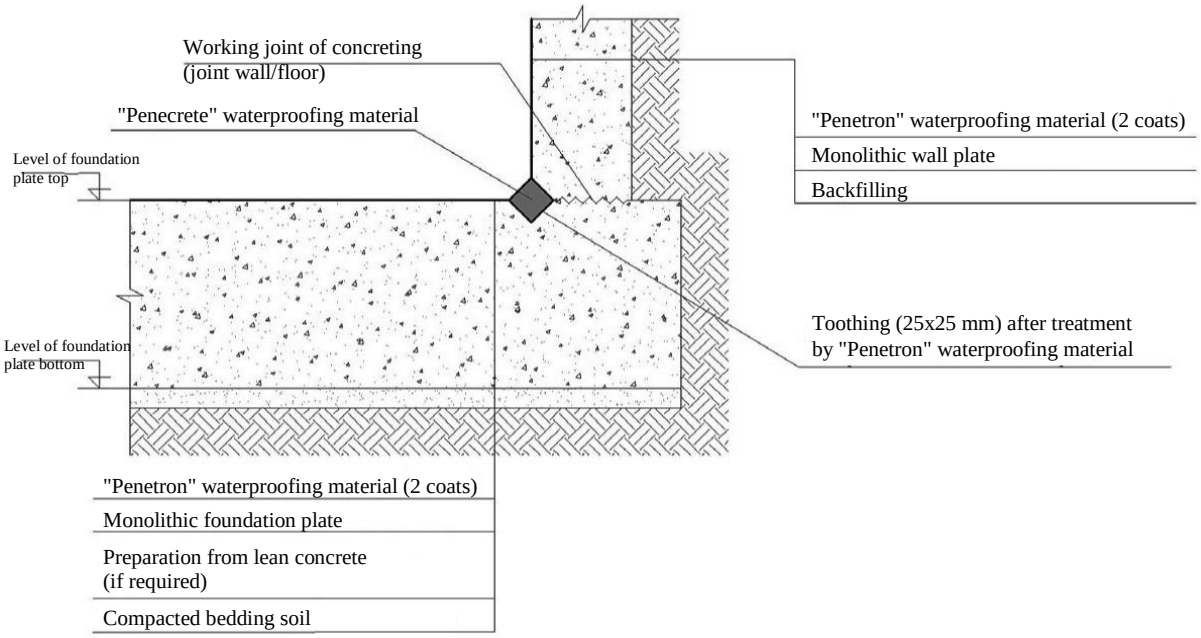
SRO RSPPPG

Variant of waterproofing with application of "Penetron Admix" and "Penebar"



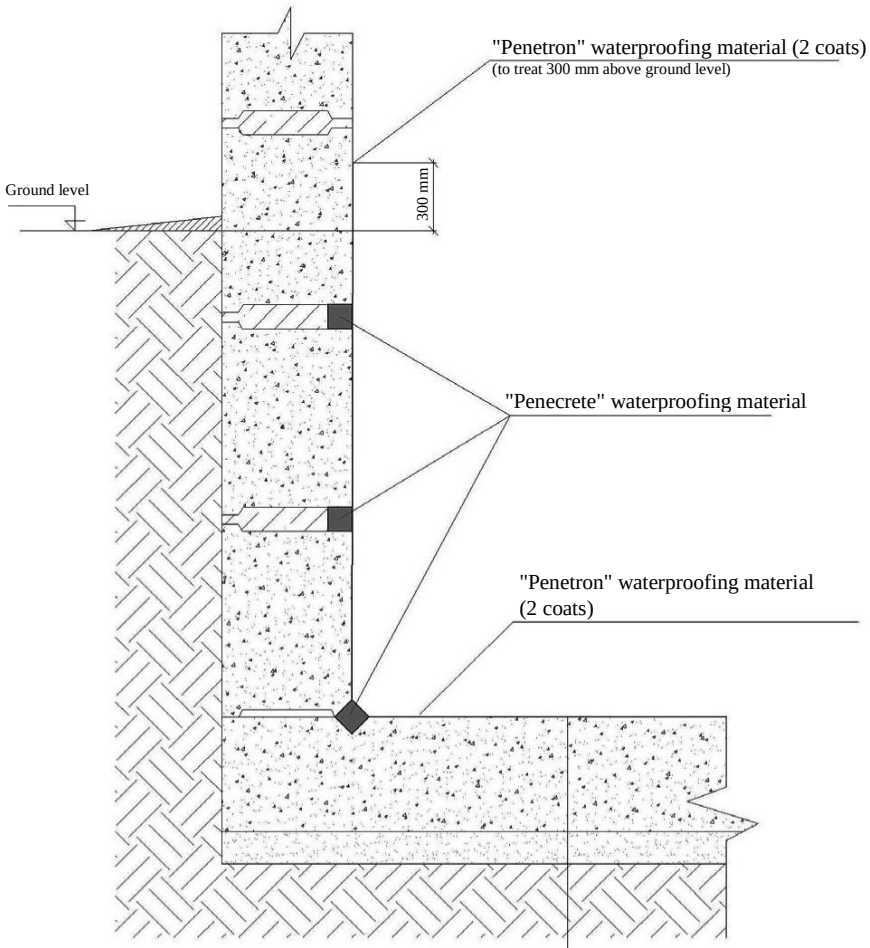
						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Variant of waterproofing with application of "Penetron", "Penecrete", "Penetron Admix" and "Penebar"	SRO RSPPPG		
Prepared by									
Checked by									

Variant of waterproofing with application of "Penetron" and "Penecrete"



						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
						Typical assemblies	STAGE	SHEET	TOTAL
Director									
Chief Project Engineer									
Team leader						Variant of waterproofing with application of "Penetron", "Penecrete", "Penetron" and "Penecrete"	SRO RSPPPG		
Prepared by									
Checked by									

Structure of concrete blocks



						SRO RSPPPG			
Rev.	Qty	Sheet	Doc. No.	Signature	Date				
							STAGE	SHEET	TOTAL
Director						Typical assemblies			
Chief Project Engineer									
Team leader						Structure of concrete blocks	SRO RSPPPG		
Prepared by									
Checked by									

TECHNICAL SUPERVISION LOG

Entries in the Log are made by person
in charge and the Log is stored by bay supervisor

Construction _____ Bay _____

Date	Stage of works	Parameters covered by technical supervision	Supervision method/tools	Shift/team in charge of work completion	Mark about supervision/ data, person in charge, signature	Remarks
	1. Identification of concrete parameters before start of waterproofing works	Identification of structure waterproofness by accelerated NDT inspection method	As per GOST 12730.5-84			
		Identification of compression strength by accelerated NDT inspection method	As per GOST 22690-88			
	2. Pre-treatment of surface for insulation	Widening of cracks, joints, adjoining elements in the form of toothing cross-section 25x25 mm minimum	Visually			
		Cleanness of concrete surface, exposed capillary structure	Visually			
		Concrete structure water saturation	Pilot wetting			

	3. Preparation of "Penetron" slurry	Cleanness and temperature of water for mixing	Visually thermometer			
		Adherence to mixing technology, ratios of components	Metering vessels, spring scale			
		Uniformity of mixture, lack of mixture stratification	Visually			
	4. Application of "Penetron" slurry	Temperature of concrete surface and environment	Thermometer, pyrometer			
		Adherence to technology of application, consumption of materials	Compliance of actual material consumption to estimated values			
		Uniformity for slurry application	Visually			
	5. Care of treated surface during 3 days after treatment	Adherence to temperature and moisture mode	Visually Thermometer, pyrometer			
		Lack of cracking and coat peeling	Visually			
	6. Identification of concrete parameters in 28 days after waterproofing	Identification of waterproofness by accelerated NDT inspection method	As per GOST 12730.5-84			
		Identification of compression strength by accelerated NDT inspection method	As per GOST 22690-88			

Attention! Stages 2-5 are mandatory for waterproofing of existing structures by Penetron system materials of penetration action.

SURVEY REPORT OF LATENT WORKS FOR WATERPROOFING

Completed on _____
(structure)

"____"_____ 20____

city _____

Commission members:
Representative of repair and building organisation chief engineering of construction _____
(name)

bay supervisor _____
(name)

Customer representatives: _____
(name, post)

inspected works completed by _____
(name of repair and building organisation)

and drawn up this Report for the following:

1. Waterproofing works were submitted for inspection _____
(structure)

Point of application	From axis….. To axis …….	Total length of welds, cracks, joints, adjoining elements and service inlets (r.m.)	From mark …. To mark …….	Total area of treated structure components (sq.m.)	Remarks
Ceiling (vault)					
Wall					
Floor (sub-base)					
Total					

Works were completed by squad _____ from "_____"_____ 20____ to "_____"_____ 20____
(supervisor name)

2. Works completed according to project _____
(name of design bureau, drawing No., date of issue))

3. During works, the following materials were used:

Material description	Lot No., date of production	Material volume

Decision adopted by Commission:

Works were completed in accordance with design and budgetary estimates, building code and satisfy requirements for work acceptance.

In view of stated above, a permit is given for subsequent works for arrangement/installation of _____

Chief Engineer _____
Bay Supervisor _____
Customer representative _____

"Hot-line" telephone: 8 800 200 7092
info@penetron.ru

Technical advice for application and purchase of Penetron system materials are offered in the following offices:

"Penetron-Russia" Group
Ekaterinburg, pl. Zhukovskogo, 1
Tel: (343) 217 02 01, 217 02 02, 217 02 03

Office in Moscow
Moscow, Ryazansky pr. 24, bldg. 2
Tel (495) 660 52 00