

Waterproofing

Road-Bridges



Design and Installation Manual

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Contents

1. Description of Siplast waterproofing systems for road-bridges	3
1.1 Parafor Ponts and Paraforix A systems	3
1.2 Compliance with regulations	4
1.3 Complementary materials	5
2. Jobsite preparation	6
3. Requirements concerning the condition of the substrate	6
3.1 Concrete substrate	6
3.1.1 Age of the concrete	6
3.1.2 Texture	6
3.1.3 Cleanliness of the substrate	7
3.1.4 Dampness and humidity	7
3.2 Substrates of bituminous covering	7
3.3 Metal substrates	7
4. Substrate preparation methods in case of off-specification elements	8
4.1 Methods for eliminating soiling and plugging holes	8
4.1.1 Eliminating soiling due to excess of injection grout	8
4.1.2 Eliminating soiling due to gas oil and to oils	8
4.1.3 Plugging holes	8
5. Laying the waterproofing membranes	9
5.1 Primer	9
5.2 Laying the membrane in undifferentiated section	9
5.2.1 General provisions	9
5.2.2 Welding and smoothing down	9
5.2.3 Arrangement of joints	9
5.2.4 Laying the asphalt carpet on the Paraforix membranes	9
5.3 Dealing with irregular points	10
5.3.1 The upstands	10
5.3.2 Downward extensions	10
5.3.3 Connection to existing structures	10
5.3.4 Protections	11
5.3.5 Traffic on the jobsite	12
5.3.6 Final roadway	12
5.3.7 Sidewalks	12
6. Acceptance inspection and servicing	12
6.1 Acceptance inspection	12
6.2 Servicing	13
6.2.1 Repairing swelling	13
6.2.2 Localized repairs of the waterproofing	14

This document describes the Parafor Ponts and Paraforix A systems for waterproofing road-bridges. The laying details as well as the precautions

to be taken for these two waterproofing systems are also described.

1. Description of Siplast waterproofing systems for road-bridges

1.1 Parafor Ponts and Paraforix A systems

■ Parafor Ponts is a prefabricated elastomeric bitumen base membrane with a non-woven polyester reinforcement.

The Parafor Ponts system, welded to Siplast Primer, is utilised for waterproofing road bridge decks and overhead walkways with protection by bituminous concrete (macadam), forming the wearing course of pavement.

■ Paraforix is a prefabricated elastomeric bitumen base membrane with a surface reinforcement of non-woven polyester.

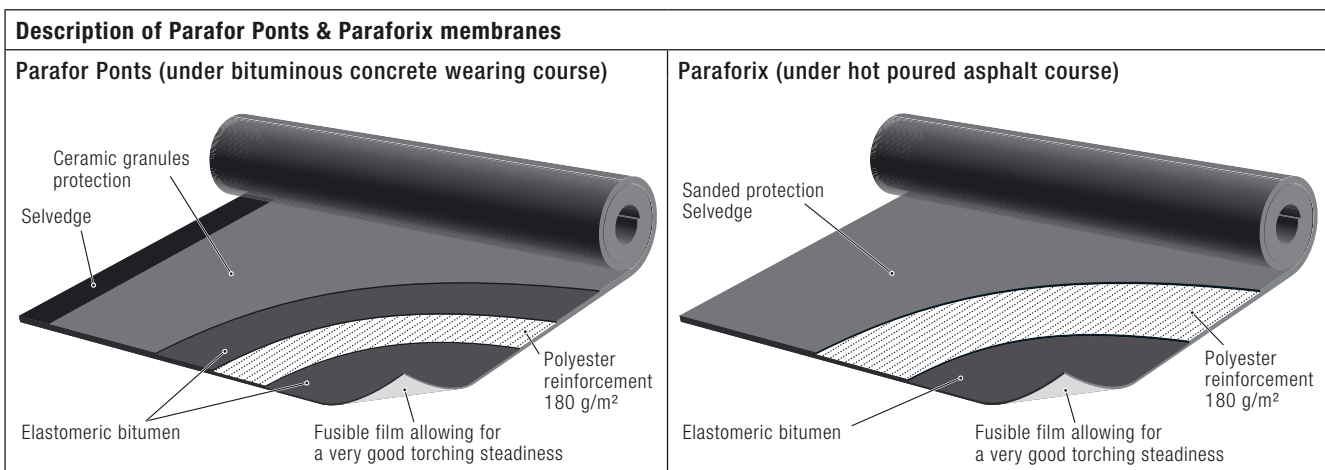
The Paraforix A system for waterproofing road-bridge decks comprises:

- ▶ the waterproofing itself (Paraforix membranes welded onto Siplast Primer);
- ▶ its fine gravel filled asphalt protection (poured mastic asphalt).

The wearing course is then laid on the protection.

■ The Parafor Ponts and Paraforix A systems are suitable for waterproofing all bridge decks and overhead walkways with hydraulic concrete substrates (reinforced or pre-stressed) or for use on bituminous coating.

For metal or timber substrates, special procedures are to be applied.



1.2 Compliance with regulations

French Regulations in the field of the waterproofing of road-bridges are detailed in the following documents:

- Leaflet 67 of the General Technical Specification Book for public works contracts (CCTG in French), Title 1, relative to waterproofing road-bridges with cement concrete substrate, brought into application by Edict no. 85 404 of April 3, 1985.
- The French Technical Assessments of the Road and Highway Technical Study and Design Department (SETRA in French). Since 1995, a Technical Assessment procedure has been developed under SETRA's Secretariat, with the participation of the professions concerned [Chambre Syndicale Française d'Étanchéité (French Waterproofing Association), USIRF¹, SNFORES, Asphalt Office], developers and main contractors.

The Technical Assessment does not replace the regulations in force, that is, Leaflet 67, Title 1 of the CCTG, but the developer can request the following in its contract:

- ▶ either the presentation of a SETRA Technical Assessment, specifying the minimal performances that the membrane must meet, characteristic by characteristics;
- ▶ or corroboration of the performances at a level equivalent to that of a Technical Assessment.

Actually, unlike in building construction, where the Technical Assessment gives a full discharge for the application of a technique with, in certain cases, the usual restrictions, the Technical Commission does not formulate an overall Assessment concerning the system, but evaluates the performances of that system, criterion by criterion.

The Technical Assessment procedure leads to harmonising the test methods and the assessment criteria. It also makes it possible to propose innovative systems.

The Technical Assessment contains two separate parts:

- ▶ a first part, drafted by the requester, describing the product or the system;
- ▶ a second part, which constitutes the assessment by the Commission of the suitability of the product for the application, all this based on tests carried out in an independent laboratory.

It is also strongly recommended that the players base their work on the document containing the recommendations for use by Main Contractors, drafted by SETRA's Civil Engineering Works Department, published in March 1983: the STER 81. It contains three sub-dossiers:

- ▶ the ST sub-dossier: servicing decks of civil engineering works;
- ▶ the E sub-dossier: waterproofing decks of civil engineering works;
- ▶ the R sub-dossier: wearing courses of decks of civil engineering works.

Furthermore, that document is accompanied by the following:

- ▶ Current technical specifications relative to surfacing and waterproofing of decks of civil engineering works;
- ▶ Guidelines for renovating waterproofing and wearing courses of decks of civil engineering works;
- ▶ Plus two updating documents:
 - no.1 concerning the complexes by "Moyens à Haute Cadence" (MHC) (Rapid Working Rate Measures);
 - no.2 concerning the techniques for localised repairs of waterproofing.

1. USIRF – Union des Syndicats de l'Industrie Routière Française (Union of French Road Industry Associations).

1.3 Complementary materials

Draining the civil engineering works

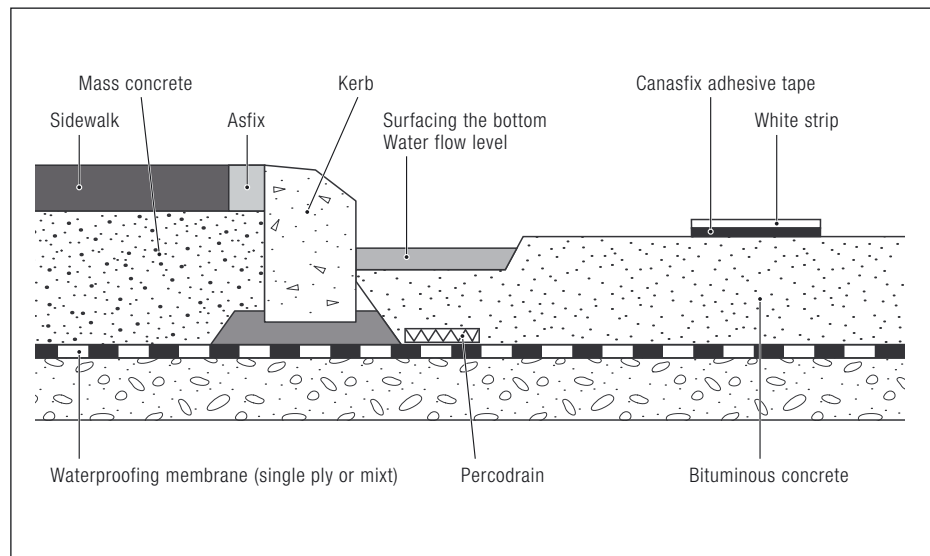
Percodrain is used to drain civil engineering works on the waterproofing and in the macadam (along the bottom water flow level, under the sidewalks, along the joints of the roadway). Percodrain consists of a thermoformed core of High Density Polyethylene (HDPE), 16 mm thick, and 60 mm wide, as well as a thick filter of polyester, which maintains a high vacuum index within the HDPE structure.

Covering for macadam gutters

Canasfix is a strip of filler charged bitumen, used for surfacing macadam to improve water flow-off (substitute for asphalt gutter). Canasfix can also be used for bonding bands (marking for example) or for cylindrical packing (of rubber, of resin and of other materials if compatible).

Pore filling for concrete substrate

Fordeck is a two-component epoxy resin base-stopping compound, used before laying a Parafor Ponts or Paraforix waterproofing membrane. Its excellent adherence to the concrete substrate enables it to eliminate swelling phenomena during hot periods.



The waterproofing membrane is laid no less than 24 h after the Fordeck is laid. The conventional techniques for welding the membrane (propane torch) remain valid.

Automated laying of bituminous water proofing membranes

A "Jetpont" machine is used for automated laying of manufactured bituminous membranes thus enabling a significant increase in the working rates. The "Jetpont" is particularly suitable for civil engineering works with areas greater than 3000 m² with an average working rate of 1000 m² / 8 h.

2. Jobsite preparation

The welding equipment necessary for laying the waterproofing systems is, as a minimum:

- ▶ One propane bottle, 13 kg or 30 kg;
- ▶ One pressure relief valve, 3 bars or adjustable from 1.5 to 3.5 bars;
- ▶ Hoses in compliance with the safety standards in force;
- ▶ One waterproofing workman's welding torch with 1 or 2 burners;
- ▶ Burins;
- ▶ One cutter with a hooked blade;
- ▶ gloves, measuring tapes, Cordex etc.

3. Requirements concerning the condition of the substrate

The Parafor Ponts and Paraforix A systems are to be used while always taking maximal account of the STER 81 Recommendations and of the Specifications of leaflet 67, Title 1 of the General Technical Specification Book of Public Contracts and of Works (Edict no. 85-404 of April 3, 1985).

3.1 Concrete substrate

3.1.1 Age of the concrete

When laying the waterproofing, the substrate's concrete will need to have been poured at least two weeks before. It is possible to work on younger substrates by using stopping compound primers, type Fordeck, epoxy resin base.



3.1.2 Texture

To receive the Parafor Ponts and Paraforix membranes without planing or dressing, the substrate's texture will need to comply with the Specifications of the STER 81 (maximal sand depth: 1.5 mm). Naturally, the slab shall contain neither holes nor rough points, nor protruding metal elements and its flatness shall comply with the directives from the developer and from Leaflet 65A of the General Technical Specification Book.

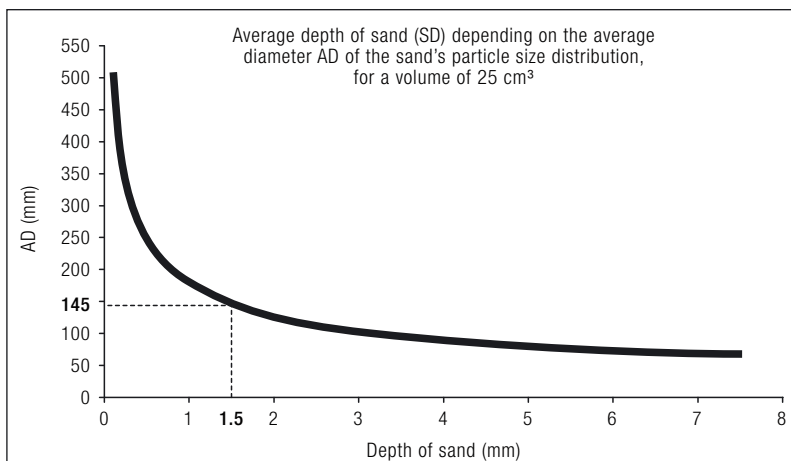
Acceptance inspection of the substrate is visual, utilising standard reference plate P2. The plate sets are for sale at the SETRA, under Reference F0232. In case of contestation, the sand depth can be measured.

Measuring the sand depth (according to Standard NF P 98 216-1).

Attention: for an application in cut & cover trench, the Association Française des Travaux en Souterrain (AFTES) (French Underground Works Association) is now recommending a maximal sand depth of 1 mm (standard reference plate P1).

To measure the sand depth, the substrate must be clean, dry and the following steps must be taken:

1. Fill a calibrated container, of 25 cm³ with sand pressing it properly flat. The sand shall be dry and its particle size distribution shall be from 0.16 to 0.315 mm.
2. Pour the contents of the cylinder onto the substrate to form a single pile.
3. Carefully spread the sand on the surface of the substrate by repeated circular movements, wider and wider, so as to form a disk (the broadest possible).
4. Measure the average diameter (AD) of the disk in mm.
5. On the adjacent graph, note the measured value of AD and determine the sand depth (SD).



Perform the same test five times on zones at least 50 cm apart. The Sand Depth will correspond to the average of these measured depths.

European Standard EN 13 036-1 is gradually replacing this test but the procedure remains essentially the same. Siplast's Engineering Department is at your disposal for all complementary information.

3.1.3 Cleanliness of the substrate

The waterproofing contractor is to make sure that the substrate is clean before applying the impregnation varnish that is check:

- ▶ that it contains no trace of hydrocarbons or of fatty matter;
- ▶ that all materials without sufficient cohesion and adherence, such as clay, dirt, dust, grout, curing compound, etc. will have been eliminated.

In particular, in case the deck is abrasive polished, make sure to eliminate the crust formed by the dust when amalgamated by rainwater. Moreover, it is strongly recommended, preferably by sandblasting or shot blasting, to eliminate all curing compound. Finally, it is necessary to definitively clean the surface to be waterproofed by sweeping and/or vacuuming, followed, if need be, with a Karcher high pressure washer with clean water.

3.1.4 Dampness and humidity

The substrate will need to be dry at the moment when the waterproofing is applied. To accelerate the elimination of humidity and dampness, the following may be used:

- ▶ a water vacuumer;
- ▶ a heating device (infrared for example).

In no case shall the water be eliminated by direct application of a flame on the concrete.

3.2 Substrates of bituminous covering

The Parafor Ponts and Paraforix membranes can be applied on substrates of bituminous covering (particle size distribution less than 0/10): tarmacadam, asphalt or surface coating. In this case, the waterproofing is to be welded directly on the substrate without impregnation varnish.

3.3 Metal substrates

Any metal substrate shall be clean, degreased, free of all swelling, then subjected to a mechanical scouring before application of waterproofing systems. The state of the substrate is defined by its degree of cleanliness and its surface roughness in compliance with Standards ISO 8501-1 and NF EN ISO 8503-1 to 4.

The following degrees of preparation are to be obtained:

- ▶ a degree of care at least equal to degree of care Sa 2,5;
- ▶ as a minimum, a degree of rust C according to Standard ISO 8501;
- ▶ as a minimum, a roughness of 12.5 µm.

According to Standard ISO 8501-1 (1988), degree of rust C corresponds to a steel on which the scale has disappeared under the effect of the rust or to a steel from which the scale can be detached by scraping, but which shows a few traces of rust, visible to the naked eye.

The degree of preparation Sa corresponds to a mode of cleaning by scouring. The degree Sa. 2.5 corresponds to very thorough scouring. The surface shall be free of any trace of oil, of grease and of soiling, as well as of nearly all material such as scale, rust, paint or foreign particles. After treatment, only minor traces may remain in the form of grime spots or streaks.

4. Substrate preparation methods in case of off-specification elements

4.1 Methods for eliminating soiling and plugging holes

4.1.1 Eliminating soiling due to excess of injection grout

- Use a cutting tool, and preferably as quickly as possible before the grout solidifies.

4.1.2 Eliminating soiling due to gas oil and to oils

- Use strong non-ionic detergents;
- Use a solution of caustic soda at 10% if the soiling is animal grease;
- Use a gas torch;
- Use water under pressure (30 to 50 MPa).

4.1.3 Plugging holes

- Depth less than 1 cm and diameter less than 10 cm: the membrane's own binder, melted with the torch;
- Depth less than 4/5 cm and diameter greater than 10 cm: mortar containing binder improved with epoxy resins;
- Depths greater than 4/5 cm: fine aggregate concrete.

The impregnation varnish will need to be applied within two hours following the cleaning.

4.2 Mechanical treatment of the substrates

The three techniques most often employed for mechanically treating substrates are sand-blasting, shot blasting (in 90% of the cases) and washing.

- **Sandblasting** is spraying, with the aid of a large compressor and a pipe, abrasive sand (or quartz) against the substrate. This technique is generally employed for the upstands or for zones that are inaccessible for the shot blasters.

- **Shot blasting** is very similar to sandblasting. The difference is that it is an automated process, with movement of the steel shot in closed circuit, enabling recovery of the dust and of the particles removed. The steel shot is sprayed at about 300 km/h.

- **Washing under very high pressure** (40 to 50 MPa).

Sandblasting and shot blasting are dangerous operations. So it is indispensable to have systems for protection against noise and against flying abrasives.

The choice of the preparation technique depends on economic criteria, but also on logistical and environmental criteria:

- **Sandblasting** is very restrictive (protection of guard panels, of personnel, etc.) and is relatively dirty for the environment. So this is a technique to be chosen outside urban zones or for localised treatment. Just the same, the result is excellent.

- **Shot blasting** requires automated equipment or bringing in a specialised contractor. The result is also excellent and, furthermore, the equipment can be adjusted as desired (machine speed or quantity of particles), which makes it possible to smooth out the substrate's texture. The equipment recycles impact particles and recovers dust. On the other hand, it does not eliminate bumps. In this case, and for localised points, mini-planers or abrasive polishers exist.

- **Washing at high pressure** (40 MPa) implies availability of water and the possibility of recovering it at the extremity of the structure. Furthermore, wetting the substrate makes it necessary to wait while it dries. But this technique also provides an excellent preparation; the adjustment of the pressure makes it possible to smooth out the result.

The efficiencies, on equivalent substrate, are approximately:

- ▶ 500 to 1 000 m²/day for the sandblasting;
- ▶ 1,000 to 1,500 m²/day for manual shot blasting and 5,000 to 6,000 m²/day with the equipped trucks;
- ▶ 1,000 to 2,000 m²/jour for the very high-pressure washing

5. Laying the waterproofing membranes

The ambient temperature for laying the Parafor Ponts and Paraforix membranes must be 0°C or warmer. The substrate's temperature must be 2°C or warmer.

5.1 Primer

Siplast Primer must mandatorily be used as cold impregnation varnish.

Before welding the waterproofing membranes, the substrate will receive a coat of Siplast Primer, about 250 to 300 g/m² for concrete substrates and 50 to 100 g/m² for metal substrates, applied with a brush, a roller or a spray gun on a dry substrate. For metal substrates, Siplast Primer is to be applied very soon after the preparation of the substrate, within a maximum time span of 2 to 3 h, in order to avoid the re-appearance of corrosion.

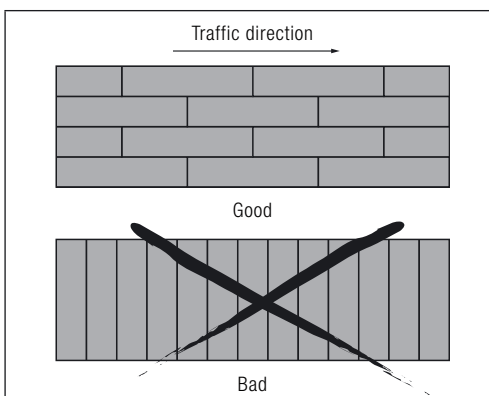
The use of a rubber spreader is prohibited, that of foam spreader is tolerated if it is followed by passing a flexible broom or a roller.

Minimal drying time for this primer is about 2 h for an ambient temperature 12°C or warmer.

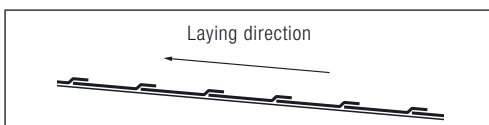
5.2 Laying the membrane in undifferentiated section

5.2.1 General provisions

The rolls of Parafor Ponts and of Paraforix are always to be unrolled in the longitudinal direction of the structure.



It is recommended that the waterproofing membranes be laid with end-laps not against the fall, beginning at the low point.



5.2.2 Welding and smoothing down

- Unroll the Parafor Ponts or Paraforix membranes and lay them out so that the prescribed overlaps are mandatorily respected (see following paragraph);
- Re-roll each strip;
- Again unroll each strip, welding it with the torch, and carefully smoothing it down;
- Force-shape the edge of each strip in order to constitute a chamfer before laying the following strip to avoid trapping air between two membranes.

It is recommended that the smoothing down be done properly:

- ▶ by hand with a damp mop for the upstands and circumscribed points;
- ▶ with a flexible damp roller in regular parts.

The time spent between applying the flame and smoothing down the membrane shall be as short as possible, as long as the membrane remains hot enough to enable an efficient smoothing down without marking the waterproofing.

The waterproofing membranes are to be welded carefully because a suboptimal heating and smoothing down may bring about the creation of low adhesion zones, and might generate swelling.

5.2.3 Arrangement of joints

The side overlaps of the strips are to be 8 cm (weld strip); the overlaps at the ends of the rollers are to be 10 cm.

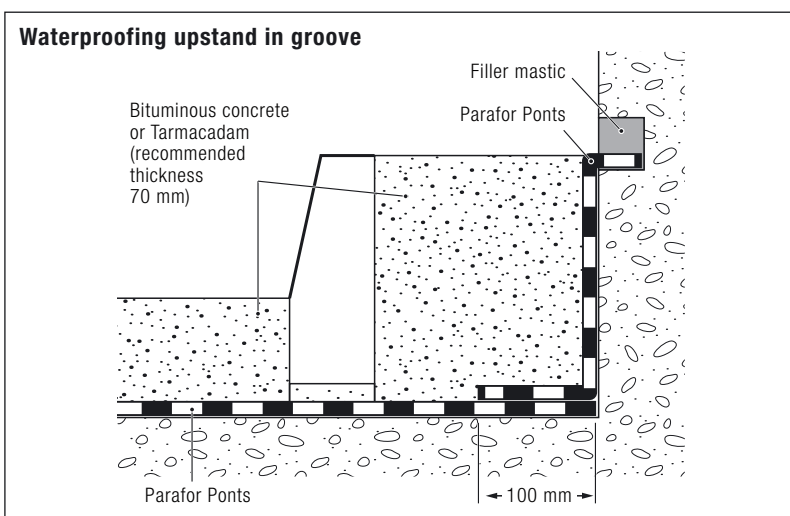
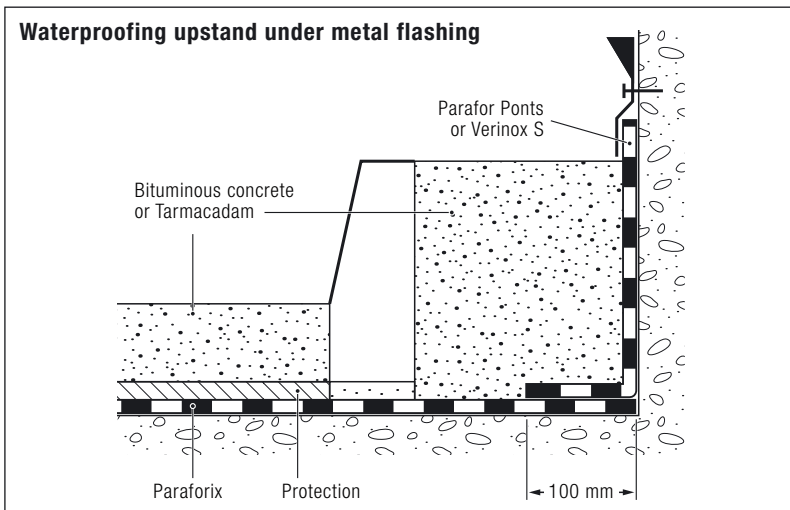
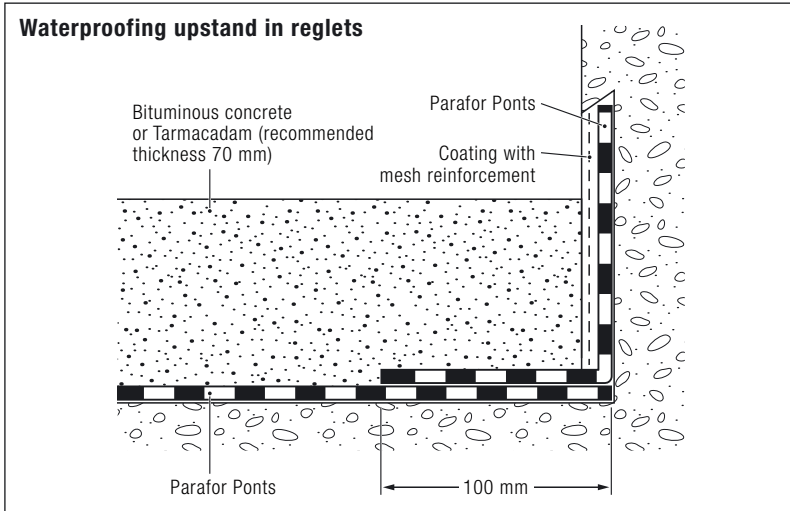
In the case of Parafor Ponts, at the ends, the strips are to be welded very carefully, after reheating, to press in, with the trowel, the granules of the lower layer in the binder of that layer.

The joints are to be offset at least 1 m so as to show no double overlap nor transversal line of joints on the deck.

When waterproofing skewed bridges, the rolls are to be arranged in the direction of the traffic. The rolls are not to be cut skewed except at the extremities of the structure. On curved bridges, the rolls are to be cut in shorter strips, arranged so that the overlap is never less than the prescribed length.

5.2.4 Laying the asphalt carpet on the Paraforix membranes

The asphalt coat associated with the Paraforix membrane is an AG3 type coat 25 mm thick according to definition in Leaflet 10 of the Asphalt Office. It is applied directly on Paraforix and the asphalt pouring joints are offset from the joints of the membrane strips.



5.3 Dealing with irregular points

5.3.1 The upstands

General guide

The upstands are to be made with the same membrane as the regular section on substrates that have been coated in advance with Siplast Primer. In practice, the SETRA permits the building of upstands after the regular part has been built.

Upstands in reglets (new works)

Reglets are to be utilised whenever possible for building upstands. The reglets shall be at least 10 cm high and 3 to 4 cm deep.

Whenever upstands are not protected by a coating or by a concrete element (kerbs, safety barriers, etc.); Veral 50 or Paradial can be used.

The lower framing toe is to be very carefully bonded on Parafor Ponts after heating so as to press the granules of the lower coat into the binder of that coat with the trowel.

Upstands with metal flashing, or groove (renovation of structures)

Whenever it is not possible to construct reglets, the top of the upstand is to be protected:

- ▶ either under a metal flashing;
- ▶ or in a groove 15 mm x 15 mm or 20 mm x 20 mm, opened in the concrete.

5.3.2 Downward extensions

At the extremities of structures containing no roadway joints, the downward waterproofing extensions are to be at least 12 cm high under the downward extension of the beam or of the bearing slab (ideally 20 cm under where the earlier pouring meets the new pouring).

5.3.3 Connection to existing structures

Connection to expansion joints

This connection will be done while ensuring the continuity between the waterproofing in regular section and the waterproofing of the joint, while, in each case, complying with the specifications in the SETRA Roadway Joint Dossier.

Whenever using Parafor Ponts waterproofing, the drain fitting's mounting plate is to be sandwiched between a surfaced Parafor Ponts membrane and the Parafor Ponts according to the diagrams below (after the collar, before installing, has received a coat of Siplast Primer).

Whenever Paraforix is used as waterproofing, the drain fitting's mounting plate is to be sandwiched between the Paraforix and the protection as shown in the diagram below (the collar having received, before the installation, a bitumen coating on both faces).

Connection under mounting plate

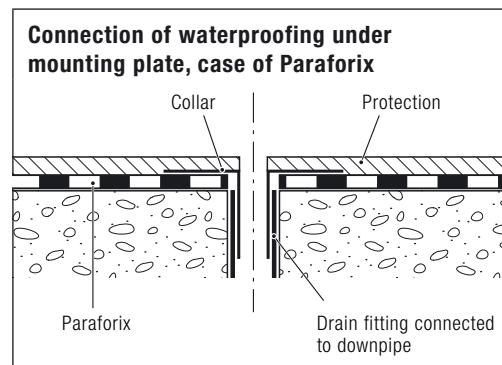
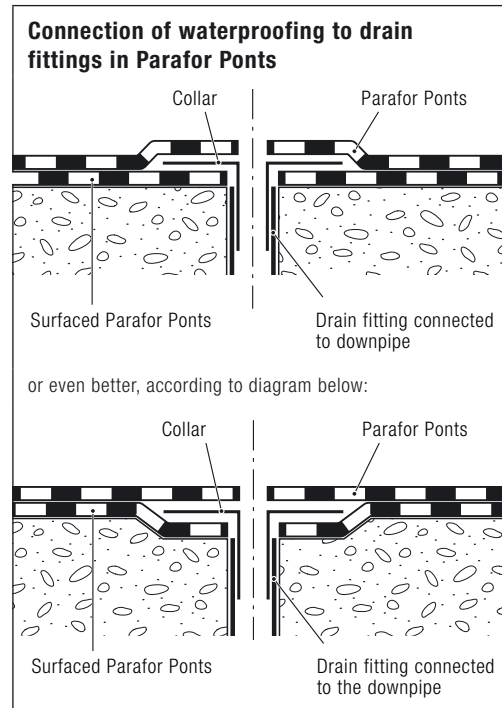
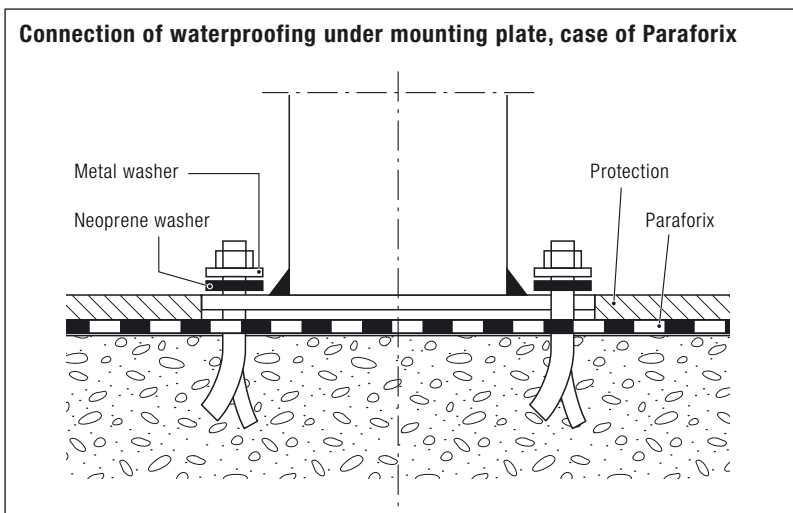
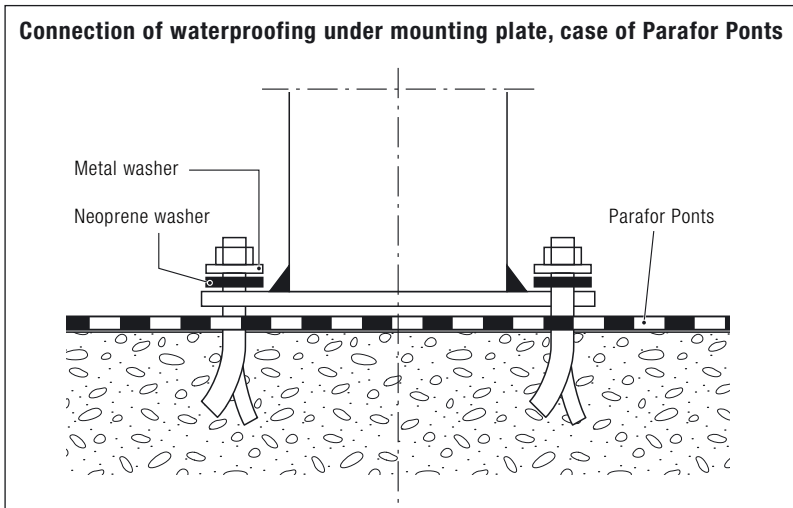
The connection under mounting plate with bolts (support of guard panels, lamp posts, safety barriers, etc.) will be especially meticulous according to the guidelines below, and according to the nature of the waterproofing.

5.3.4 Protections

Whenever the waterproofing is installed using Paraforix, the protection will consist of 25 mm of type AG3 mastic asphalt according to Leaflet 10 of the Asphalt Office.

Whenever the Paraforix A system remains exposed during periods when the sun's rays are strong, it is highly recommended to install, on the waterproofing system, a coat of reflective white acrylic paint.

Whenever the waterproofing is applied to Parafor Ponts, the wearing course of hot applied macadam, laid in one or several coats, will directly constitute the protection. If the macadam cannot be laid rapidly, it is recommended that the waterproofing membrane be protected by a geotextile, covered with a layer of sand, of earth or of a material of fine particle size.



5.3.5 Traffic on the jobsite

The Parafor Ponts and Paraforix systems can take light jobsite traffic, as well as traffic related to the laying of the coat of tarmacadam for the Parafor Ponts or of the asphalt for the Paraforix. Make sure that any manoeuvre is avoided which might damage the membrane such as, for example, steering-lock in place, sudden braking, prolonged parking in the sun.

In case heavier traffic is planned, the waterproofing is to receive a protection as recommended in compliance with § 5.3.4.

5.3.6 Final roadway

The wearing course shall be laid rapidly to avoid formation of swelling on the waterproofing. Beyond a period of two weeks (less in a period of strong solar radiation), it is recommended that the waterproofing be laid on protections as described in Paragraph 5.3.4.

On the Parafor Ponts and Paraforix A systems, the definitive roadway is to be built of macadam 0/10 without tack coat. For any other particle size distribution, please consult our Engineering Department. The thickness recommended for the layer of macadam necessary to protect the system is 7 cm on Parafor Ponts and 5 cm on Paraforix A.

In the case of Parafor Ponts, for lesser thicknesses of macadam, it is recommended that a Fordeck type epoxy resin pore-filling primer be applied.

5.3.7 Sidewalks

Whenever waterproofing is to be applied on Parafor Ponts, the protection may be one of the following types:

- ▶ of 2 to 3 cm of bituminous fine aggregate concrete (0/6);
- ▶ of fine gravel poured asphalt, at least 20 mm thick, with Kraft paper isolating sheet;
- ▶ of reinforced concrete slabs, poured in place or precast. In this case, the isolation between the waterproofing system and the tiling or paving mortar will be non-woven polyester felt, 250 g/m² minimum, covered by a polyethylene film, at least 200 µm thick;
- ▶ of interlocking slabs, the thickness of which is to correspond, according to the application conditions, to the specifications of the “Syndicat National des Fabricants de Produits en Béton” (SNFPB) (National Association of Manufacturers of Concrete Products);
- ▶ of tiling or mosaic paving. In this case, the isolation between the waterproofing system and the tiling or paving mortar will be by a polyester non-woven felt, 250 g/m² minimum, covered by a polyethylene film, at least 200 µm thick. As to tiling, please refer to the laying guidelines of DTU* 20.12.

On sidewalks, pedestrians may walk directly on the Paraforix A system.

*Documents Techniques Unifiés (Unified Codes of Practice)

6. Acceptance inspection and servicing

6.1 Acceptance inspection

The main contractor determines acceptance inspection. A visual inspection is carried out to verify proper homogeneity and good continuity of the waterproofing, absence of wrinkles, of cracks, of blisters, etc.

Acceptance inspection of the Parafor Ponts and of the Paraforix

At its expense, the main contractor will carry out the tests necessary to make sure that the product delivered complies properly with the expected characteristics.

Acceptance inspection of the quality of the incorporation of the waterproofing membrane

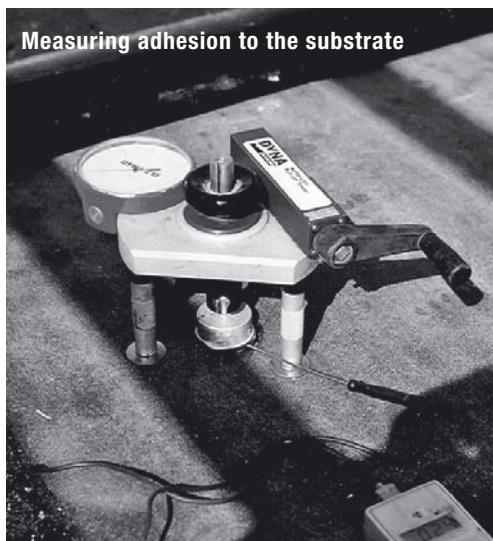
The STER 81 proposes to carry out, at the main contractor's expense, an pull-off test every 200 m² with a minimum of six tests on the deck.

The adherence to the substrate shall be determined in compliance with the recommendations of the SETRA and according to Standard NF P98-282. The bond strength depends on the temperature. Therefore, when possible, work should be done in temperatures as close as possible to 20°C. This guideline cannot be guaranteed on the worksite so measurements are to be made and interpreted within a range from 10°C to 30°C. The temperature is measured at the surface of the substrate and shall be measured for each test surface immediately after the end of the test.

The curves of bond strength as a function of temperature of the Parafor Ponts and of the Paraforix are shown further on.

The adhesion test consists of exerting a direct tension on steel patches, bonded to the surface of the waterproofing membrane after the test surface

has been defined by cutting an incision around the patch down to the substrate. The tension is applied with an adhesion measurement instrument, strong enough to cause a break between the membrane and the substrate. The tensile force is applied perpendicular to the substrate's plane. The instrument shall have a measurement system indicating the force applied. The tension on the patch is applied at a speed of 1.65 mm/min.



Measuring adhesion to the substrate

European Standard NF EN 13596 is gradually replacing this test. A tension is always exerted perpendicular to the plane but the tensile stress is applied at a constant speed 0.15 N/s/mm².

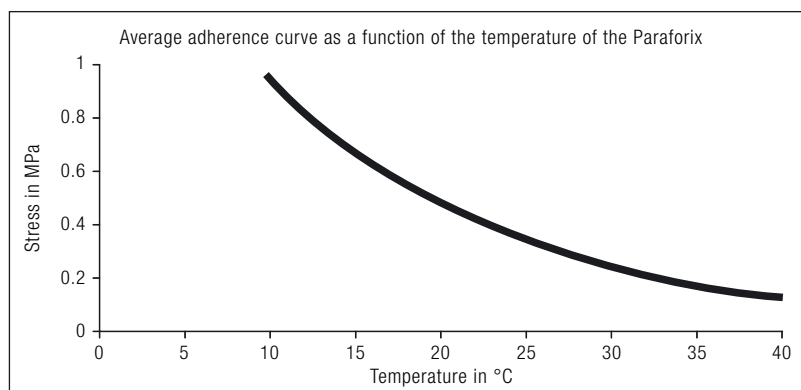
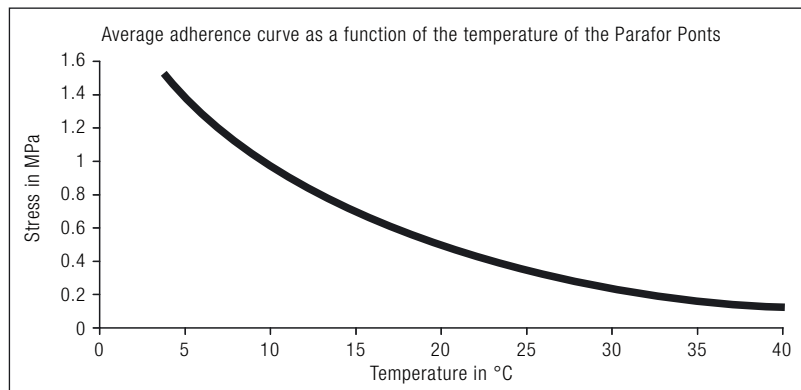
6.2 Servicing

The developer or its delegate shall monitor the servicing of the wearing course in such a way as to ensure permanent protection of the waterproofing.

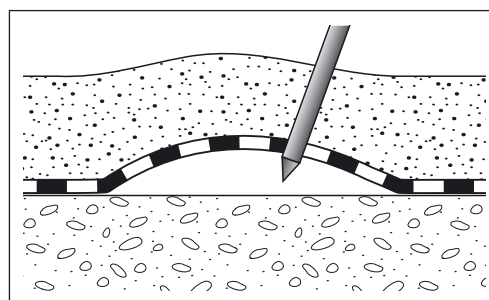
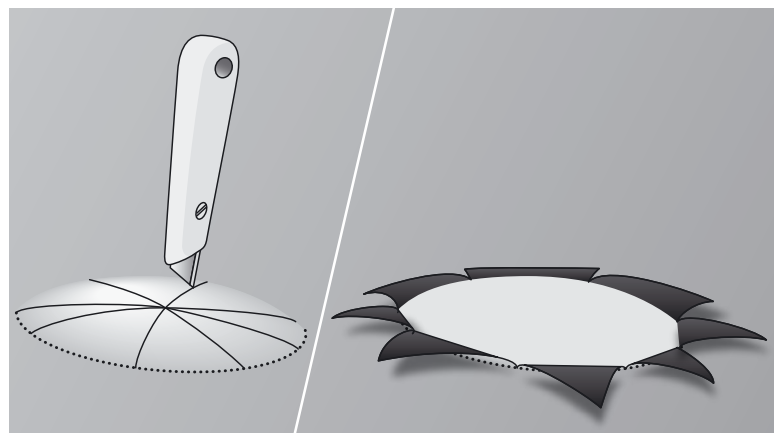
6.2.1 Repairing swelling

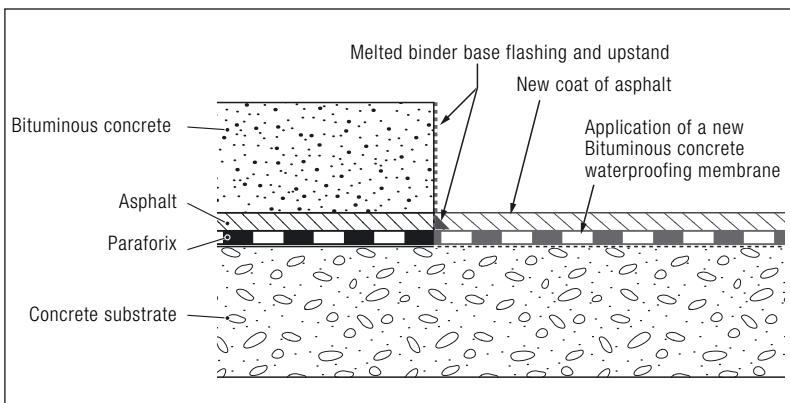
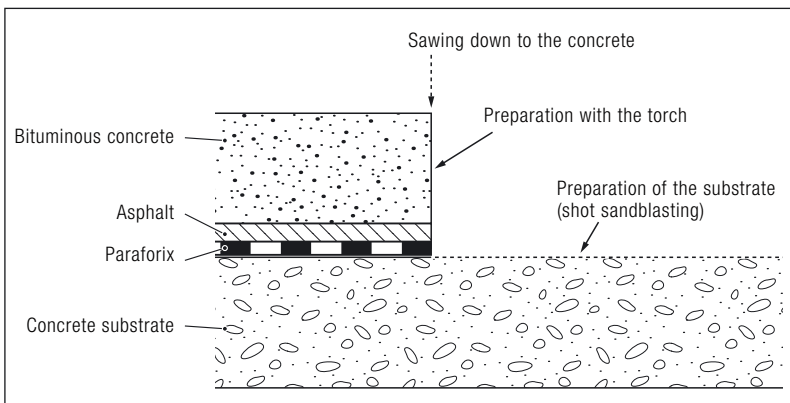
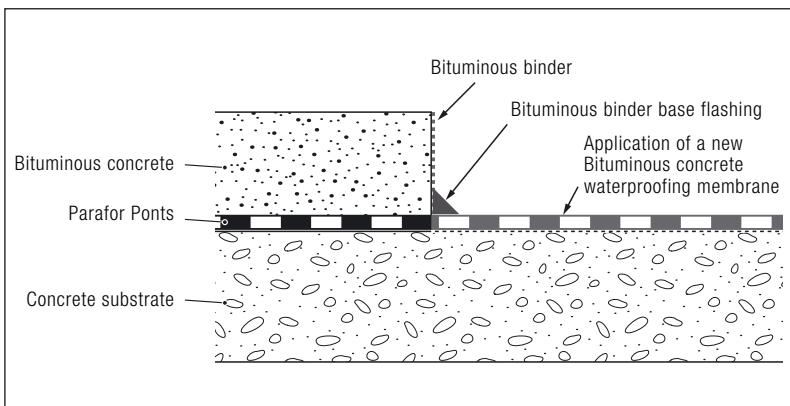
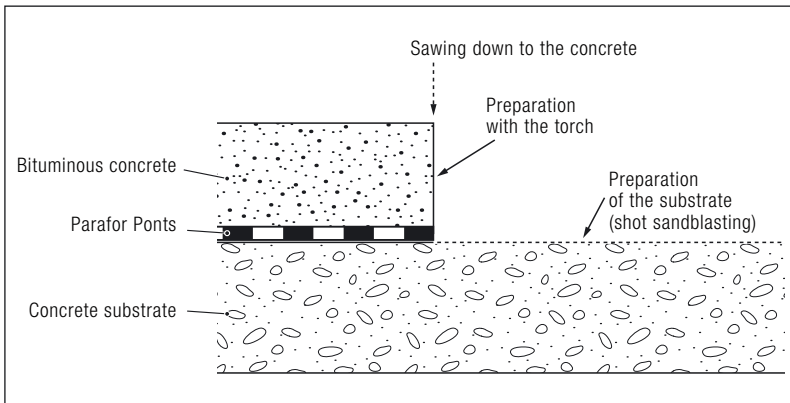
Swelling is repaired by opening the blister until its periphery is adherent, then re-welding the non-adherent parts. A piece of membrane is then welded on the repair. The piece will be made of Parafor Ponts or of Paraforix according to the waterproofing system already in place.

When the blistering occurs during the laying of the first course of the roadway, a pointed tool may be used to pierce the swelling and let the trapped gas escape.



Opening the blister up to the zone where the membrane becomes adherent on the substrate





6.2.2 Localized repairs of the waterproofing

For localised repairs of the layers of the waterproofing, refer to updating no. 2 of the STER 81. Whenever the waterproofing has been made using Parafor Ponts, the first step is to saw the system down to the concrete and to free the zone. The concrete substrate surface is to be prepared (for example, by shot blasting) to make it possible to apply a new layer of waterproofing. As to the bituminous concrete face, it receives a treatment using the torch.

A new Parafor Ponts waterproofing membrane is then applied. The vertical layer of bituminous concrete is coated with the melted binder of the membrane. Next a flashing is formed with the same melted binder as shown in the adjacent figure. The last step is to re-stop with bituminous concrete.

Whenever the waterproofing is made with the Paraforix A system, the first step is to saw down to the concrete substrate and free the zone. The concrete substrate is prepared mechanically and the face of the bituminous concrete is treated with the torch.

A new Paraforix membrane is applied. As indicated above, a flashing and an upstand is made with the melted binder of the waterproofing membrane. A new coat of fine gravel filled asphalt is laid. Then a re-stopping is done with the bituminous concrete.



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