

State-of-the-art natural sealants

INSTALLATION GUIDE



GBL Geofelt Bentonite Liners

BENFELT - Installation Guidelines



1. What is BENFELT mat?

BENFELT is a geosynthetic clay liner produced by sandwiching a layer of bentonite, a clay mineral which expands when wet between two or more layers of geotextiles. Bentonite absorbs water from the surrounding soil, its expansion is impeded by layer pressure from the geotextile membranes creating an impermeable lining material able to be used as a containment barrier. BENFELT replaces the need to use all traditional mineral sealants, it offers better sealing performance, it is more cost-effective and Eco-friendly, these are the reasons that you should choose the BENFELT solution.

2. What is BENFELT C mat?

BENFELT C is a remarkable, safe and natural alternative that can be used for the conventional sealing of waterproof buildings. BENFELT C is a highly effective bentonite waterproofing mat. It is a composite of 3 materials, bentonite and woven and non-woven polypropylene geotextiles. The integrity of these 3 components is ensured due to a patented needling process. A polymer membrane can also be laminated to the non-woven surface.

3. What is BENFELT CS mat?

BENFELT CS is an isolating non-permeable product which is constructed using two component parts:

1. The Geosynthetic barrier: PE, PP, PVC. This permanently protects the product against water penetration and leaching of toxic substances.
2. The Geosynthetic Clay Liner (GCL): The excellent absorption properties of bentonite renders the GCL impermeable.

The self-sealing properties of the bentonite layer secure the integrity of the product in the event of damage to the geosynthetic layers. This distinguishes BENFELT CS from other products that also use bentonite as a main component.



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1. General Information

BENFELT is a mat consisting of three elements (geo-textile, geo-fabric and layer of granulated bentonite) bound by stitching. Due to the used materials and as a result of the applied production technology, BENFELT has very good sealing and mechanic parameters. The bentonite, as a result of strong stitching, is so pressed between the geo-synthetic materials that, upon installation of the mat, it cannot swell freely. This is why the wet mat, lying, for instance, in an excavation, can increase its thickness only slightly. Apart from that, in case of mat damage during works or upon their completion, due to the possibility of further bentonite swelling, the damaged spots are closed and sealed automatically. Another feature resulting from the applied technology and materials is the lack of dislocation of bentonite inside the mat. Furthermore, the bentonite cannot be flushed out. A well measurable effect of the above properties is the possibility to use the mat regardless of atmospheric conditions. Due to the use of geo-textiles, the material has great breaking strength and is resistant to significant deformation. BENFELT additionally designated with letters CS is laminated with PE foil on one side.

BENFELT (also CS) is projected to be used under reinforced concrete slabs, at least 10 cm thick - in the case of its installation directly on thickened soil ground. If lean concrete is used a substrate, thickness of the pressing reinforced concrete slab must be at least 15 cm. The mat is water insulation. It can be used as moisture protection. BENFELT/BENFELT CS is used for erection of new buildings and in repair works. The order of works is as follows: prior to setting BENFELT, it is necessary to prepare the ground in a proper manner. In advance, lift pits, wells, chambers, board ribs and pile heads are also insulated, leading out BENFELT overlaps from these elements for the purpose of continuous, uninterrupted insulation belt. During works, the desired size of the overlap must be observed at the penetrations under the expansion joints, technological joints and continuous joints of the horizontal and vertical insulation.

BENFELT is installed with its darker side (geotextile) from the side of the insulated element (e.g. in the case of insulation under a slab, with its darker side upwards). BENFELT CS is laid with the foil from the pressing water side, e.g. in the case of foundation insulation - with foil from the ground side.

The ground for BENFELT (also CS) can be concrete substrate, stabilised soil ground, thickened soil or layer of thickened aggregate. The ground soil of aggregate layer must be levelled and thickened. In the case of thickened aggregate grounds, aggregate with variable continuous granulation and maximal grain size below 18 mm must be used. The ground can be moist and even wet. No offsets exceeding 5 mm are allowed. Unevenness is levelled by means of cement mortar or bentonite putty. In case of soil grounds, it is also possible to use sand.



2. Horizontal setting

Under continuous footings or foundation board, BENFELT (BENFELT CS) must be set on properly prepared ground (fig. 1, 2). The adjacent belts must be set in overlaps, min. 10 cm. The overlaps of the ends of the belts must be shifted against each other by at least 30 cm (fig. 3). In order to provide protection against drawing apart or contamination of the overlaps, it is recommended to nail the mat to the ground along with overlaps with nails and washers during reinforcement and concrete works. The span between the nails must be 40 cm.

If the board is made in stages, BENFELT from the previous stage must extend at least 30 cm over the edge of the already set board. This will allow to make the overlap and provide proper connection with the insulation under the next board section. In the case of installation of BENFELT CS, the mat is set similarly, however the foil is unstuck from the mat within the overlap area. The overlap must have the foil-foil / mat-mat form (layers from the bottom). Upon consultation with the Manufacturer or Distributor, it is admissible to make overlaps, as in the case of mat without the foil (BENFELT), i.e. without unsticking the foil from the mat.

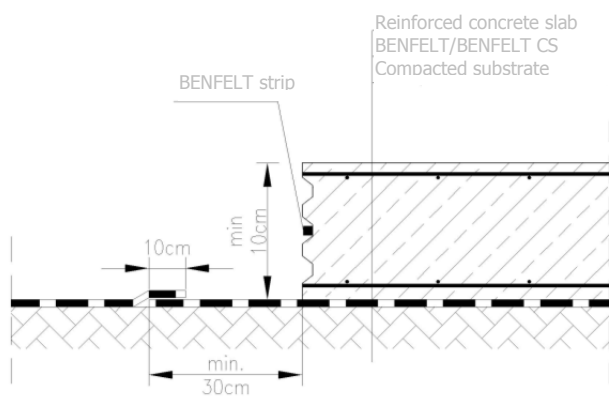


Fig. 1. Construction joint in concrete works of the foundation board – on layer of stabilised soil ground.

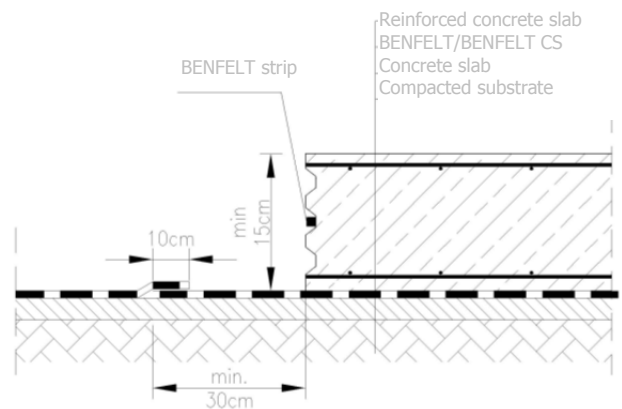


Fig. 2. Construction joint in concrete works of the foundation board - on layer of thickened concrete pad.

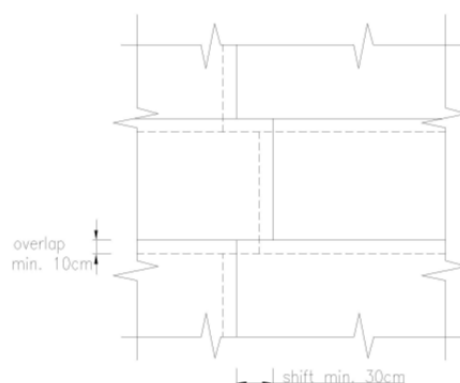


Fig. 3. Diagram presenting setting the mat under the foundation board



In the case of penetration under an expansion joint, proceed as follows: it is recommended to set an additional mat belt, at least 80 cm wide (40 cm on both sides of the expansion joint), along the expansion joint (fig. 4). The mat providing basic insulation must be led outside the already made element, extending for at least 60 cm. BENFELT (BENFELT CS) does not provide sealing of the expansion joint breaks. All construction joints in concrete works must be provided with the BENFELT strip tape.

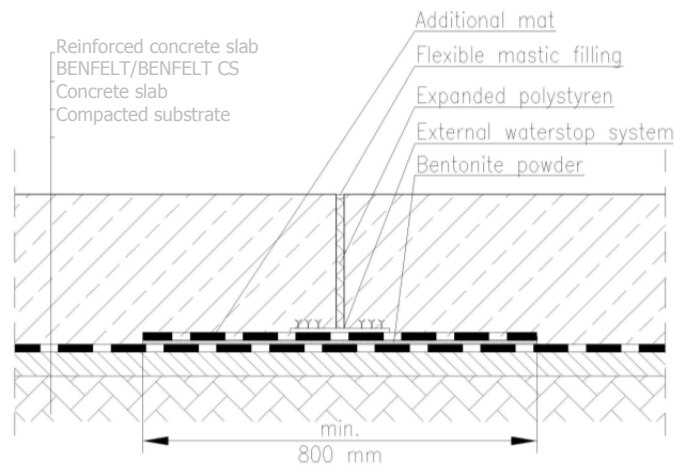


Fig. 4. Installation of the mat under the expansion joint of the foundation board - sealed with the external expansion joint tape.

2.1. Pile caps and foundation board ribs

BENFELT (BENFELT CS) should not be set directly on the piles. It must be properly cut in order to adjust it to the pile shape (fig. 5). Having set BENFELT, the place of its contact with the pile must be covered with abundance of bentonite putty. A ring must be made from the putty around the pile, with triangular section, the legs of which must be at least 5 cm long. On top of the pile, around the protruding reinforcement, set a continuous belt of the BENFELT tape. In the case of ribbed foundation boards, the entire rib must be covered with BENFELT. This is made by lining the interior of the rib planking with BENFELT prior to placement of reinforcement (fig. 6). At least 30 cm of excess BENFELT material must be led out, allowing for further connection to the basic board insulation.



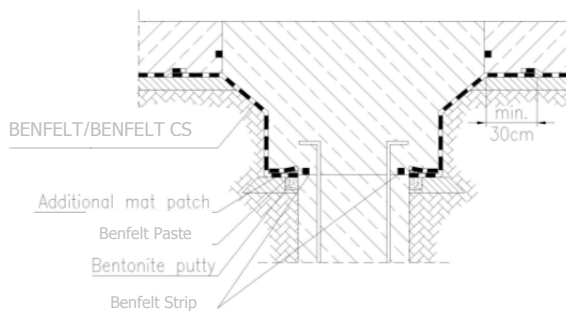


Fig. 5. Detail of pile cap insulation.

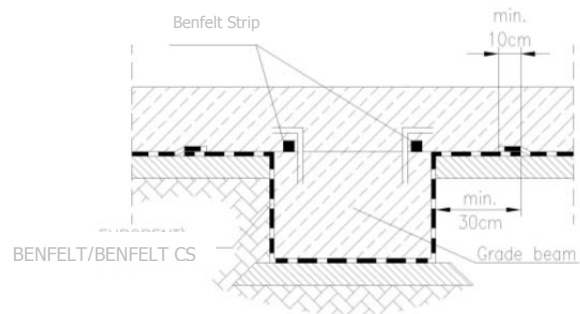


Fig. 6. Foundation board rib insulation.

2.2. Lift pits

The lift pits and other types of deepest set building elements must be carefully covered with BENFELT from the soil side, providing continuity of insulation and uninterrupted binding to the basic horizontal insulation (fig. 7). In the cases where the walls of the lift pit excavation are sufficiently stable, BENFELT can be set directly on the soil. Whereas, when the walls chip off or can chip off, they must be planked and BENFELT must be set on the resulting retaining wall. A masonry wall or properly set concrete elements can also be used as ground. BENFELT can also be fitted to the internal surface of the external wall formwork. In all cases, the mat must be led out onto the horizontal surface for the purpose of proper continuity of the basic board insulation. The width of the excess must be at least 30 cm.

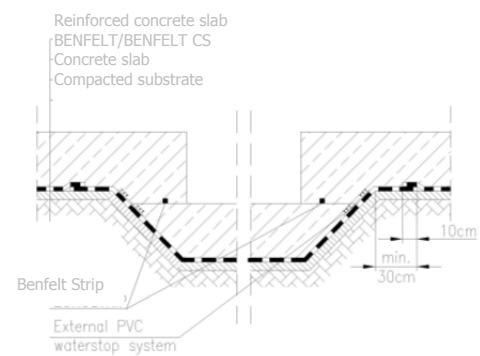


Fig. 7. Insulation of the lift pit or board trim.

BENFELT Strip tapes must be installed in all construction joints of the concrete works. In the case of water pressing, in addition to the BENFELT Strip tape, external polymer sealing tapes or injection hoses are often used. If the insulation route goes through vertical corners (inner and outer), the material must be set in such a manner that the vertical edge of the belt is located at the distance of at least 30 cm from the corner.



2.3 Installation penetrations through the boards

During installation of BENFELT (BENFELT CS), the shape of the penetrating duct must be cut out in it, and having set it, the place of contact on the entire circumference of the pipe or duct must be covered with bentonite putty (fig. 8). The putty must protrude over the duct and BENFELT by ca. 4 cm. In order to secure this sealing, it is recommended to set an additional mat patch, size 80 x 80 cm (the size regards pipes with diameter up to 400 mm). An opening must be cut in the patch, corresponding to the shape of the penetrating duct. Putty must be placed on the edges of the patch, between the proper insulation and the patch. It is recommended to nail the patch or cover it with putty. In the spots where the board is penetrate by a group of ducts near each other, cutting openings for each of them might prove impractical (fig. 9). It is then more beneficial to adjust the cut to the external circumference of the duct group and cover the space between them with a layer of bentonite granulate, at least 1 cm thick. All this must be finished with a thick layer of bentonite putty. In order to provide additional sealing, it is recommended to wrap the installation ducts with swelling bentonite BENFELT Strip tape.

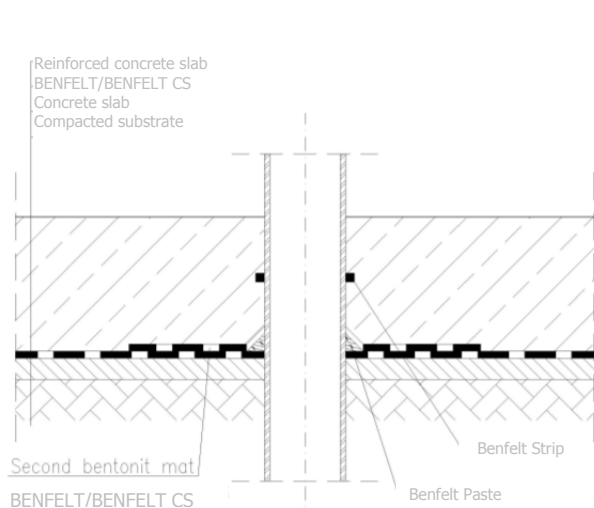


Fig. 8. Sealing of the installation pipe penetration through the foundation board.

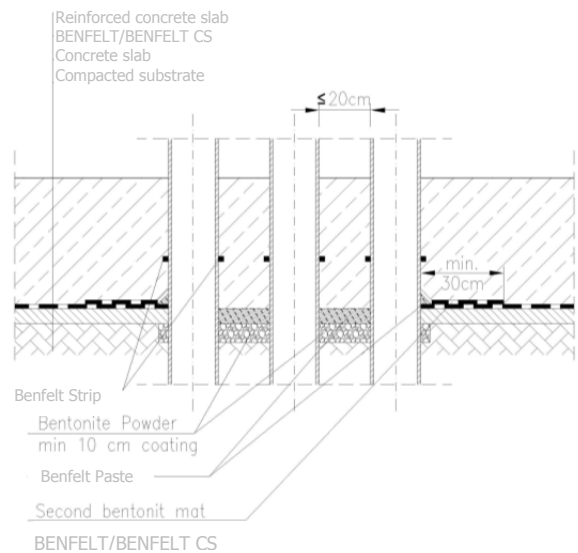


Fig. 9. Sealing of the duct group penetration through the foundation board.

2.4 Passage of the horizontal insulation onto the vertical surfaces

When the horizontally installed BENFELT reaches the external periphery of the board, it must be flanged onto its formwork (fig. 10, 11, 12). Next, it must be cut, leaving at least 30 cm of spare material. After boarding, the left excess will be used for the purpose of continuous connection with vertical insulation. The width of such an overlap should not be less than 10 cm. It is also admissible to cut the BENFELT led out to the vertical surface below the upper edge of the board. In such a situation, in order to make the insulation continuous, the set vertical insulation of the walls must overlap the previously made insulation, forming an at least 30 cm thick overlap.



If the horizontal insulation flanged onto the formwork is damaged, or the insulation in the bottom corner of the board is damaged, proceed as follows: make a groove in the ground, along the board edge, and fill it with bentonite granulate. The groove size must be be at least 10 x 10 cm (fig. 13). The bottom edge of the set vertical insulation from BENFELT must be set in the prepared groove filled with the bentonite granulate.

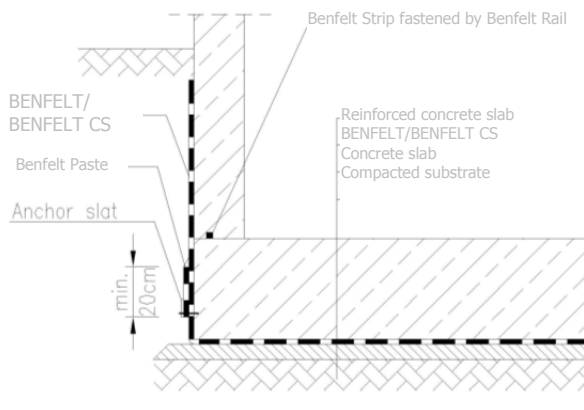


Fig. 10. Methods of passage from horizontal to vertical insulation - Variant I.

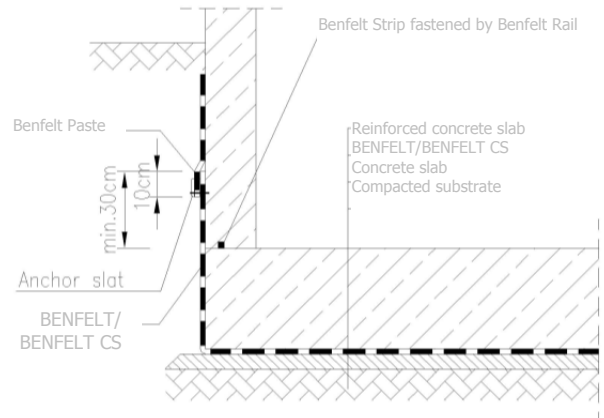


Fig. 11. Methods of passage from horizontal to vertical insulation - Variant II.

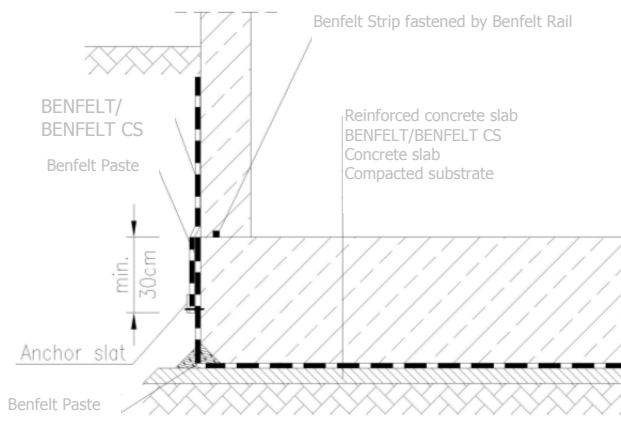


Fig. 12. Methods of passage from horizontal to vertical insulation - Variant III.

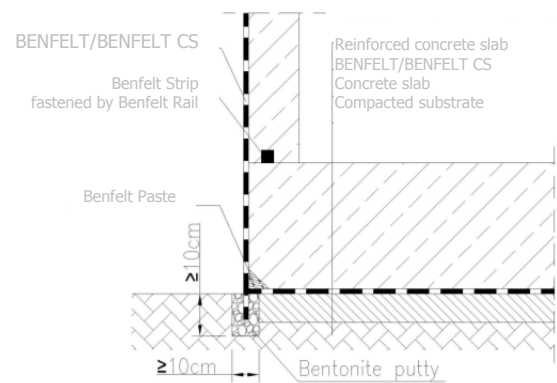


Fig. 13. Providing continuance of the horizontal and vertical insulation by means of setting in the groove filled with bentonite granulate.



In the corners, BENFELT must fully adhere to the ground and surface of the formworks. It cannot be stretched or protrude. In the inner and outer corners, the mat by the properly cut to adjust it to the corner shape. The cutting spots must be abundantly covered with bentonite putty. If possible, set patches in these spots, nailing them or covering them with putty. The size of the patch must be sufficient to extend over the cut by at least 20 cm in each direction. If the mat is not flanged onto the board formwork, it can be led out horizontally under the formwork, leaving at least 30 cm of spare material. In this case, special attention must be given to security of the mat against damage. The mat is then fixed to the vertical surface according to the instructions provided in the section regarding insulation on vertical surfaces. The mat is fitted to the formworks by means of a wire or nailing. After boarding of the fixing spot, apply putty and, if needed, fit patches. In the connection spots of the board and wall, along the entire circumference, install the BENFELT Strip bentonite tape. It is admissible to use additional external sealing tape (fig. 14, 15, 16).

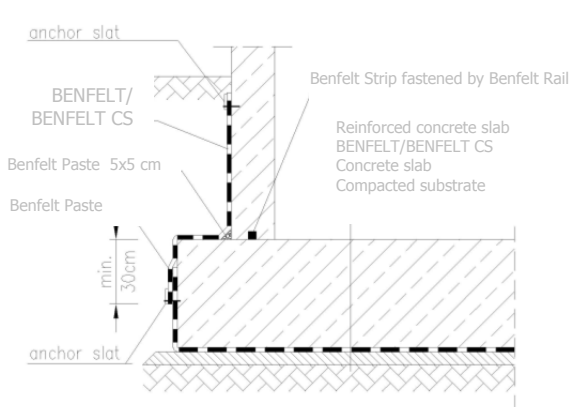


Fig. 14. Passage of the horizontal insulation onto the foundation wall in case of a board with offset - Variant I.

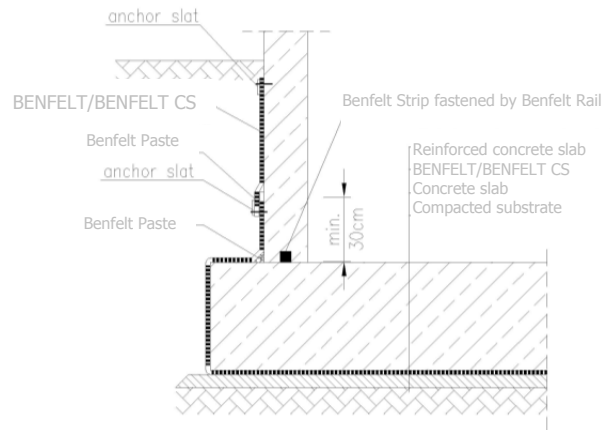


Fig. 15. Passage of the horizontal insulation onto the foundation wall in case of a board with offset - Variant II.

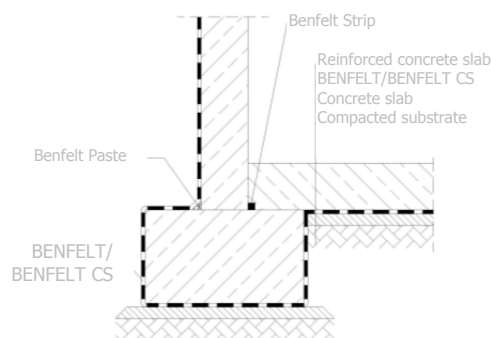


Fig. 16. Flooring board above the continuous footing.



In the case of use of retaining walls, such as Berliner walls, sheet pile walls or pile walls, providing also planking of the structure, BENFELT set horizontally must be led out upwards onto the wall, with at least 30 cm over the upper surface of the board (fig. 17). It is essential to leave 30 cm of spare BENFELT as there will be no access to the external edge of the board after it is covered with concrete. Another method, e.g. in the case of steel sheet pile walls, is to cut the BENFELT set horizontally evenly with the corrugated wall surface (fig. 18). Then, in the spot of contact of BENFELT and the wall, a triangular 4x4 cm plaster cove is made of granulate or bentonite putty. In the end, vertical belts of BENFELT, properly cut on the bottom side, are fixed to the wall, with 30 cm overlap joints with the horizontally set BENFELT.

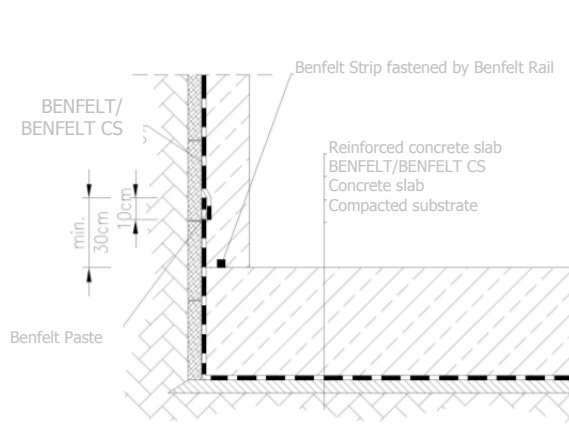


Fig. 17. Passage of the horizontal insulation onto the fixed excavation cover development.

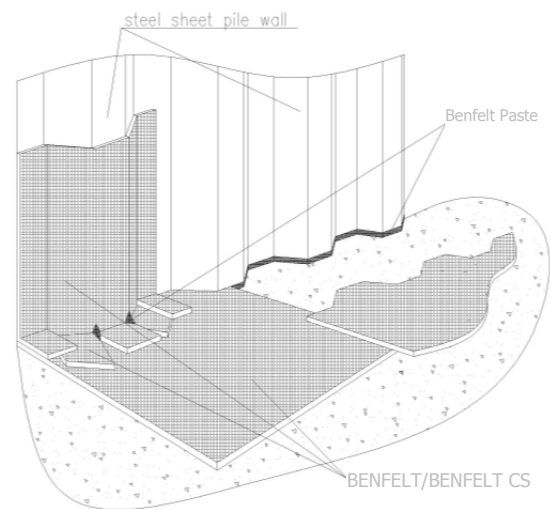


Fig. 18. Connection of the horizontal and vertical insulation set on sheet piles.

2.5 Removal of mat damage

In order to remove the BENFELT (BENFELT CS) mat damage occurring during its setting, reinforcement and concrete works, etc. (e.g. tears, cuts of the mat in its corners, fitting spots and penetration of the formwork joining elements), the following activities must be performed: clean the damage spots and apply the bentonite putty. Then, place the patches fixing them by means of putty or nailing. The patch size must be selected in such a manner that it protrudes over the damage spot by at least 20 cm in each direction.



3. Vertical setting

BENFELT (BENFELT CS) is also designed to perform insulations of vertical surfaces of underground parts of buildings. The mat is water insulation. It can be also used as moisture protection. BENFELT CS is used for erection of new buildings and in repair works. In the first case, the mat is set in traditional manner on the already prepared structure. It is fixed by nailing to the wall. The other method consists in fixing the mat to the surface of the external formwork of the foundation wall or fixed excavation cover development as well as coverage in concrete together with the wall. In such a case, the mat is bound with the structure element covered with concrete. BENFELT is installed with its darker side (geo-textile) from the side of the element. BENFELT CS is set with its foil from the side of pressing water, e.g. in case of insulation of foundations - foil from the soil side. The mat can also be installed on fresh concrete, directly after wall planking. The order of works is as follows: clean and prepare the ground prior to installation of BENFELT. Next, the mat is laid. Remember to set the mat with overlaps with the already made horizontal insulation in such a manner as to create a continuous, uninterrupted insulation belt. During works, pay attention to preservation of the desired size of the overlap at the penetrations through expansion joints and construction joints.

3.1 Surface preparation

The surfaces of the walls must be properly resistant and smooth, free from sharp concave and convex spots that could cut BENFELT after it is pressed with the soil filling the excavation. Sharp protrusions (over 1 cm) must be removed and levelled with the wall surface. Sharp edges of the outer corners must be bevelled. Trims and unevenness must be filled with cement mortar or bentonite putty. Openings resulting from the stays must be filled with shrinking cement mortar and covered with bentonite putty. When filling the opening for the purpose of additional sealing use the BENFELT tape (fig. 19) Fragments of the tape are placed between the filling mortar layers, with tape lagging by means of putty of min. 7.5 cm. B, offsets and other elements must be thoroughly cleaned, so that the bentonite putty and BENFELT have direct contact with the insulated surface.

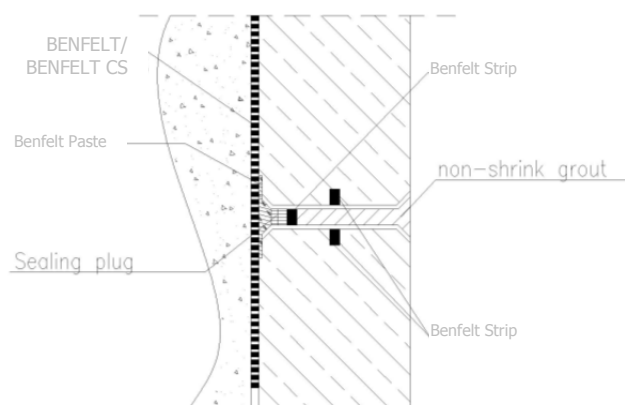


Fig. 19. Sealing detail in the area of openings remaining after framework stays.



3.2 Installation

BENFELT is fitted to the prepared foundation walls by nailing or by means of studs with washers. The mat is nailed along the overlaps and the distance between the fixing elements must be 30-40 cm. The inner corners (e.g. in the place of the offset at the contact spot of the wall and continuous footing) must be covered with bentonite putty, forming a rounded plaster cove.

The mat bands can be set horizontally or vertically. The BENFELT installation starts from one of the external wall corners. In each case, the mat edge must protrude over the inner or outer corner by at least 30 cm. In the corners, BENFELT must adhere to the ground. It cannot be over-stretched or protrude. In order to adjust the shape to the corner, the mat can be cut. The cut places must be abundantly covered with bentonite putty. It is recommended to set a patch on it, fitting it by means of putty or nails. It is necessary to place patches in the outer corners. The patch size must be sufficient to overlap the cut by at least 20 cm in each direction.

The next bands of BENFELT must be set in overlaps, of min. 10 cm. The width of the overlap on the connection of the set vertical insulation with excess material led out of the horizontal insulation must be less than 10 cm, in certain situations - 30 cm (as shown in the proper drawings). The BENFELT overlaps in the consecutive rows must be shifted against each other by at least 30 cm. They must be made in a manner preventing drawing aside or contamination during coverage with concrete or aggregate. In case of horizontally set BENFELT bands, having set the given row, fill the foundation excavation, creating an installation bridge for the consecutive higher bands. The material filling the excavation must be properly thickened.

If the mat is set in direct contact with the gravel aggregate of the drainage systems, it is necessary to use BENFELT CS. In the case of installation of BENFELT CS, the mat is set similarly, however the foil is unstuck from the mat in the overlap area. The overlap must have the foil-foil/mat-mat form (layers from the outside) (fig. 20). Upon consultation with the Manufacturer or Distributor, it is admissible to make the overlaps as in the case of the mat without the foil (BENFELT), i.e. without unsticking the foil from the mat.

In the case of setting of BENFELT patches on the proper insulation, it is recommended to fix the patches by means of nailing upon previous edge lutting.

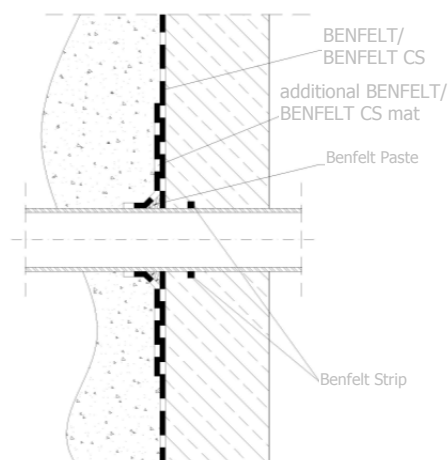


Fig. 20. Sealing of the installation pipe penetration through the foundation wall.



3.3 Installation penetrations through walls

The procedure is almost identical as in case of penetrations through horizontal insulation. The shape of the penetrating duct must be cut out in it, and having set it, the place of contact on the entire circumference of the pipe or duct must be covered with bentonite putty. The putty must protrude over the duct and BENFELT by ca. 4 cm (fig. 26). In order to secure this sealing, it is recommended to set an additional mat patch, size 80 x 80 cm (the size regards pipes with diameter up to 400 mm). An opening must be cut in the mat, corresponding to the shape of the penetrating duct. Putty must be placed on the edges of the patch, between the proper insulation and the mat. It is recommended to nail the patch or cover it with putty. In the spots where the board is penetrated by a group of ducts near each other, cutting openings in BENFELT for each of them might prove impractical. It is then more beneficial to adjust the cut to the external circumference of the duct group and cover the space between them with a layer of bentonite putty, at least 2 cm thick (fig. 21). In order to provide additional sealing, it is recommended to wrap the installation ducts with swelling BENFELT Strip tape.

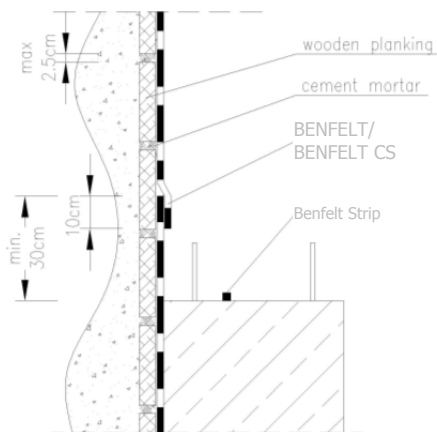


Fig. 26. BENFELT set directly on the balk planking.

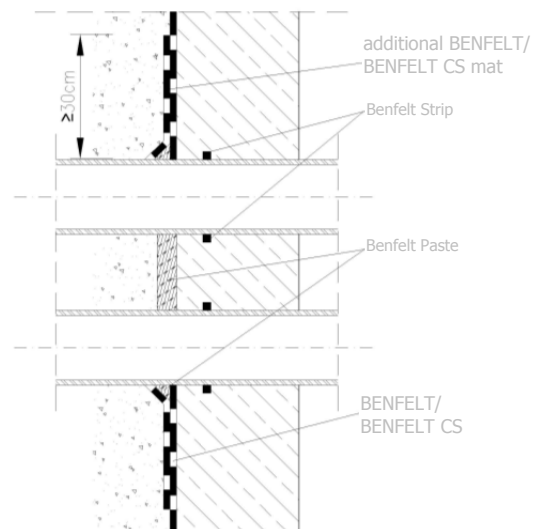


Fig. 21. Sealing of penetration of a duct group through the wall.



3.4 Finishing at the ground surface

Prior to installation of the last bands of the mat, it is necessary to provide the wall with moisture insulation led out over the ground level. The BENFELT overlap and insulation must be at least 15 cm. Installation of BENFELT on the wall must be finished at the depth of ca. 20 cm below the ground level. Within the area of the overlap with moisture insulation, the wall must be luted with bentonite putty, forming a 5 cm thick layer. Then, fit linearly the upper edge of the mat by means of anchor slats. The upper edge of BENFELT and the slat must be covered with a layer of bentonite putty (fig. 22). Details of finishing treatment are presented in corresponding drawings.

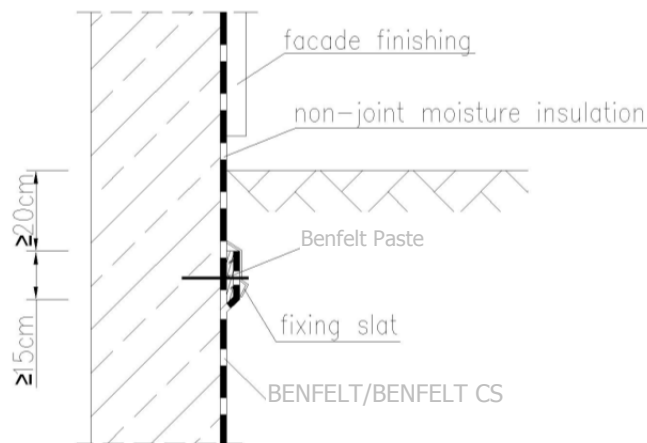


Fig. 22. Details of insulation finishing at the ground level.

3.5 Structure coverage

The mat must be covered in stages, along with completion of the particular stages of works. The fill must be made in layers of 20-30 cm, carefully thickened. The thickening of the particular layers must be controlled (recommended density level ID 0.8). The fill can be made by means of any soil approved by the supervision, with the following restrictions. The used material must be a non-cohesive soil, it must have variable continuous granulation and cannot contain rubble, sharp stones, roots, etc. It is not recommended to use soil with high calcium content. The maximal grain size is 25 mm. In case of mat damage during covering, the damaged spot must be immediately cleaned and repaired. Use of the BENFELT mats (BENFELT CS) does not require any pressing walls or mats, or other protective elements.



3.6 Masonry walls

If lime or cement-lime mortar is used for masonry works, it must be removed up to the depth of 2 cm. The resulting grooves as well as entire surfaces must be levelled by means of cement mortar. Further installation must be conducted according to the instructions provided in previous paragraphs, and in the case of masonry walls, it is recommended to use BENFELT CS.

4. Mat installation on fixed excavation cover developments

Use of construction methods described in this section allows to erect buildings with external dimensions almost equal to the building plot dimensions. BENFELT is the most effective solution to provide water insulation for the building when the fixed foundation excavation cover developments fulfil also the structure planking function. These are Berliner walls, steel sheet pile walls, cavity walls, drilled pile walls, etc. In the particular cases, it is necessary to refer to the corresponding points of this section, containing information regarding ground preparation and detailed installation instructions. Similarly to fixed excavation cover developments, the mat is installed in performance of insulation of the underground parts of the infill buildings.

The adjacent bands of BENFELT are set in overlaps of at least 10 cm, and fixed to the cover development with nails or studs. It is necessary to nail the mat at least on the vertical and horizontal edges. The span of the fixing elements is ca. 30 cm. The overlaps in the given direction (horizontal and vertical) must be shifted against each other in such a manner that they are not drawn apart during concrete works. BENFELT installed on vertical surfaces must be joined in overlaps with the mat led out from beneath the board. The width of the overlap on the joint of the set vertical insulation with the excess material led out from the horizontal insulation cannot be less than 10 cm.

In order to provide penetration for the installation ducts and anchoring stay heads through BENFELT, proper cuts must be made in BENFELT. After BENFELT is carefully fitted, the contact spot must be luted with bentonite putty, filling the free spaces between the penetrating element and the cut mat. In the case of penetration of a duct group, cutting holes for the particular ducts is improper. In such a case it is necessary to make a cut corresponding to the external

circumference of the duct battery, and the space between them must be covered with a layer of bentonite putty, min. 2 cm thick, reaching to each pipe. In order to provide additional sealing, it is recommended to wrap the installation ducts with BENFELT Strip bentonite tape.

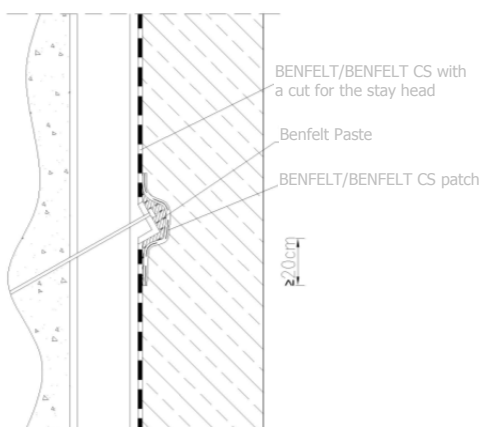


Fig. 23. Detail of anchoring stay head sealing.

In the spots of penetration of the anchoring stay heads, cut the mat in the "x" letter shape. Then, the heads of the anchoring stays must be covered with a layer of bentonite putty, at least 2 cm thick, protruding onto the BENFELT by at least 5 cm (fig. 23).

Place a patch cut out from a separate piece of BENFELT onto the luted stay head, where the overlaps with the primary BENFELT should be at least 20 cm. The overlaps and all cuts must be thoroughly luted.



4.1 Berliner walls

The spaces between the boards cannot exceed 2.5 cm. In the cases where they are wider, they must be filled with cement mortar. If ground water penetrates through the cover development, it is necessary to cover the planking with polyethylene foil, 0.15 mm thick, prior to setting of BENFELT, or install BENFELT CS.

On surfaces with wider spaces between the boards (5-10 cm), install OSB type chipboards on their surfaces. The trims along the edges of the double-tee girder shelves and the board cover must be levelled by filling them with bentonite mortar.

The provided drawings present installation methods for BENFELT with various planking positions in relation to the double-tee girder shelves (fig. 24, 25, 26, 27, 28).

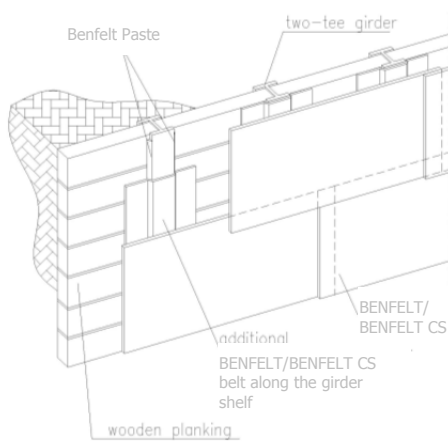


Fig. 24. Installation of BENFELT on the fixed excavation cover development made of Berliner wall.

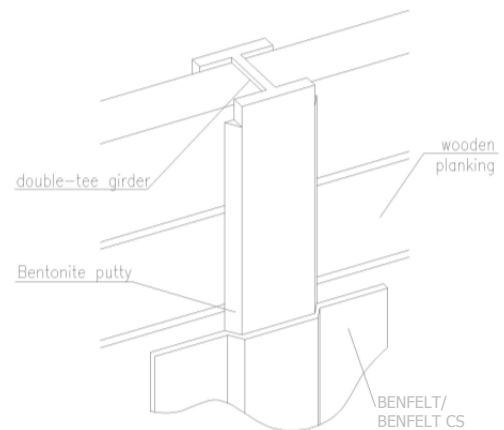


Fig. 25. Bevelling with putty of the sharp offset between the girder shelf surface and the wooden planking of the excavation cover development.

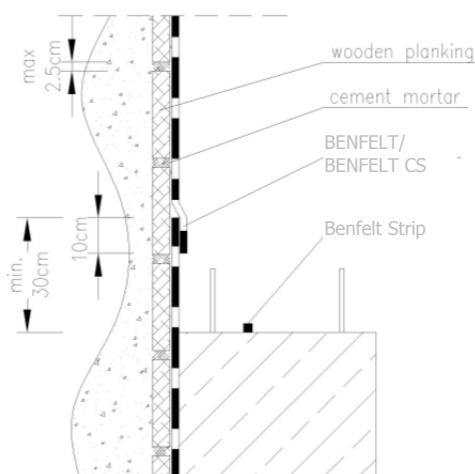


Fig. 26. BENFELT set directly on the balk planking.



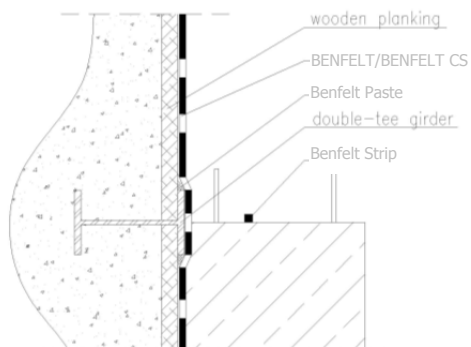


Fig. 27. Cover balks on the internal girder shelves - top view.

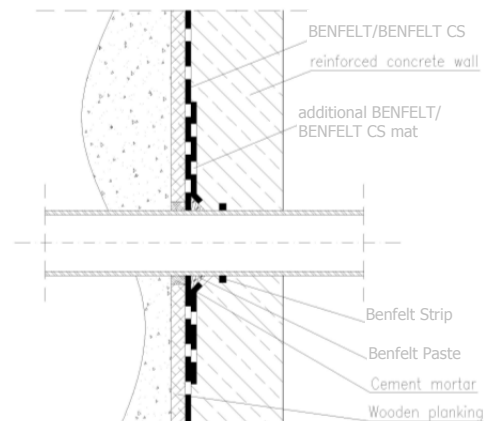


Fig. 28. Detail of duct penetration through the Berliner wall.

4.2 Cavity walls

Upon performance of the excavation, in the case of hollow spots or sharp protrusions exceeding 2 cm on the surface of the cavity wall, they must be levelled with the wall surface. Then, the surface must be evened with cement mortar. BENFELT can be also set on vast, relatively shallow and mild concave surfaces of the wall. BENFELT is installed on the prepared ground according to the instructions provided in p. 3.1. Set a pressing layer on the insulated surface.

4.3 Steel sheet pile walls

All joints of sheet piles and anchoring stay heads must be covered with bentonite putty (ca. 2 cm). In case of water leakage through the sheet pile joints, the water leakage must be stopped by means of BentogROUT injection (fig. 29). BENFELT is set on the wall surface according to the convex and concave surfaces and fixed to the sheet piles by means of gun-studding by the use of large washers.

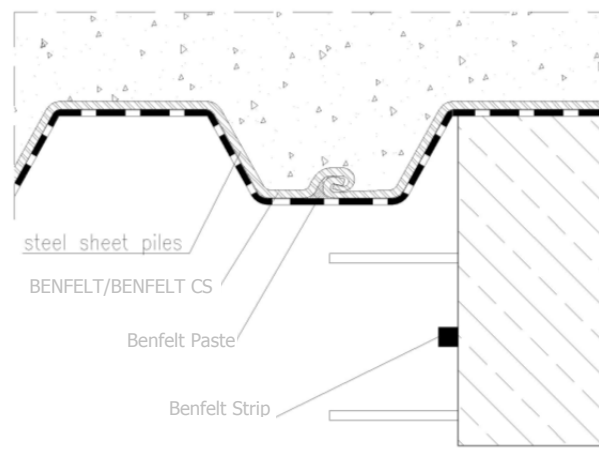


Fig. 29. Detail of sealing of the steel sheet pile joint - top view.



4.4 Drilled pile walls

Due to the significant unevenness of surface of such a structure, it is usually covered with a layer of sprayed concrete. Shotcrete, as the substrate for BENFELT, can be also set directly on the vertical walls of the excavation if the soil type so allows (fig. 30). In all cases, BENFELT must adhere to the ground on its entire surface: it is inadmissible, for instance, to fix it in convex places of the ground and stretch it over concavities. As in the other cases, here also: the more even the ground, the more efficient and simple the installation of BENFELT (fig. 31). Make a pressing layer on the insulated surface.

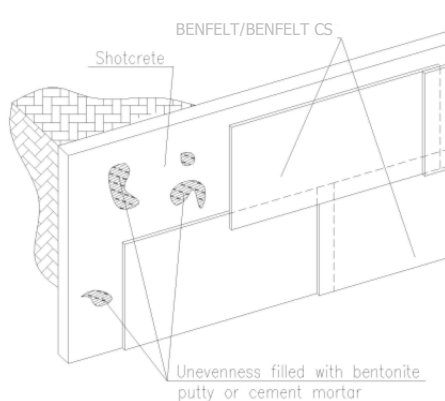


Fig. 30. Installation of BENFELT on shotcrete layer placed on horizontal walls of the foundation excavation.

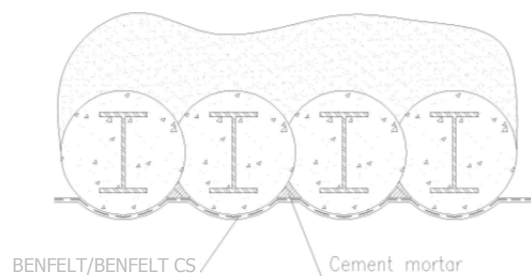


Fig. 31. Instruction of installation on fixed cover development made of piles - top view.

4.5 Variant with plywood planking

When choosing this variant, the ridges of the sheet piles are fitted with planking that will provide a substrate for the set BENFELT. The slits in the planking must be filled with cement mortar or bentonite putty.

4.6 Installation of the mat on foundation wall formworks

BENFELT (BENFELT CS) can be installed on the internal surface of the external foundation wall formwork and covered with concrete together with the structure.

The mat is installed by nailing it to the formwork. The mat must be installed with surplus (along the bottom and one of the side edges), used to make overlaps in order to keep continuity of the insulation (e.g. with insulation led out from beneath the board). Then, the formwork board is transported to the place of installation. During concrete works and concrete binding, the mat is bound to the structure. After boarding, the mat is already installed. It is necessary to carry out a control of the overlaps. In order to secure them against drawing apart, the loose bands of the mat must be nailed to the structure and the nailing place must be luted with bentonite putty. The openings left after the fixing elements of the formwork boards must be filled according to the instructions provided in p. 3.1. The openings in the mat must be covered with BENFELT patches, fitted by nailing to the structure. If the upper edge of the mat is left loose, it must be fixed and finished properly. Proceed according to instructions from p. 3.1.



5. Tunnels and slab roofs covered by soil

This section discusses the principles regarding performance of insulation of tunnels made in open excavations. In case of tunnels made by means of mining techniques, in order to develop the proper technology, consult the Manufacturer. It is recommended to use BENFELT CS for the insulation of tunnel ceilings. The mat installed on the tunnel ceiling is continuation of the previously at bands under the foundation and on the external walls. BENFELT CS on the ceiling must be set with foil from the soil side. In the described application, BENFELT requires pressing with a concrete layer, 20 cm thick, or thickened soil, 60 cm thick. Installation of horizontal installation under the board and vertical insulation on the walls is discussed in points 2 and 3 of this catalogue.

In case of installation of BENFELT CS on surfaces with slight inclination, prior to its setting it is necessary to distribute a layer of BENFELT bentonite granulate, at least 3 mm thick, on the entire surface of the ceiling. Then, immediately proceed to setting the insulation (fig. 32).

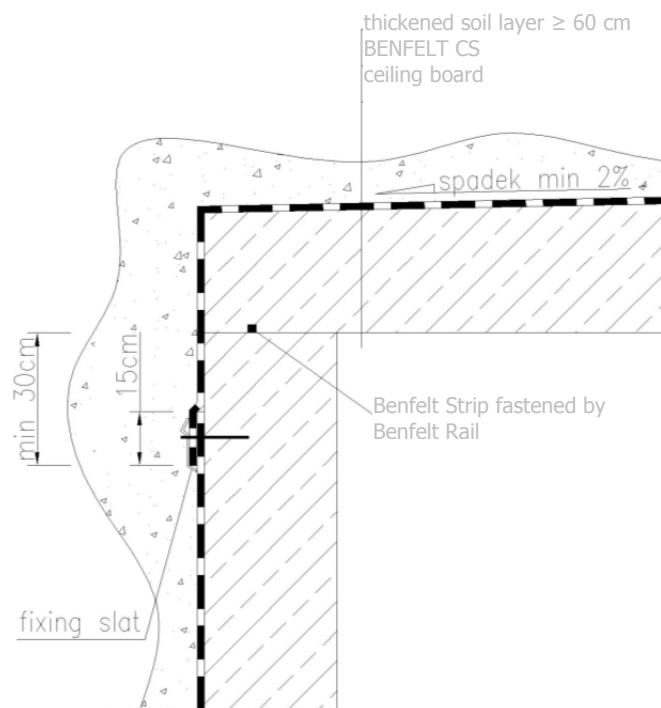


Fig. 32. Detail of installation on the tunnel ceiling.

Setting of BENFELT CS is carried out from the lowest to the highest point, installing it transversely to the inclination, to obtain a tile system of the consecutive bands. The adjacent bands must be set in overlaps, min. 10 cm. In case of BENFELT CS installation within the overlap area, the foil is unstuck from the mat. The overlap must have the foil-foil / mat-mat form (layers from the top). Upon consultation with the Manufacturer or Distributor, it is admissible to make overlaps, as in case of mat without the foil (BENFELT), i.e. without unsticking the foil from the mat. The band end overlaps must be shifted against each other by at least 30 cm. In order to secure the overlaps against drawing apart or contamination, it is recommended to nail the mat to the ground along the overlaps, with nails with washers. Distance between the nails - 40 cm.

The mat set on the ceiling must be led out to the vertical wall surfaces. Its bottom edge must be located at least 30 cm below the contact spot of the ceiling and the wall. This insulation must be led out with at least 15 cm overlap onto the previously made vertical wall insulation.

Direct motion of the equipment on the mat is inadmissible during refilling. In case of performance of the pressing layer from soil or aggregate, it is necessary to use material with variable continuous granulation and maximal grain since below 25 mm. It is recommended to make a 5 cm concrete layer directly on the mat. Then, the next covering layers are set. In order to provide proper pressure and protection, it is necessary that the soil layer thickness is at least 60 cm. The pressing layer must be properly thickened.

6. Additional information

Strongly contaminated ground waters and grounds with high calcium content. At the seaside, in coastal regions, or, for instance, in industry degraded areas, the ground waters can contain high concentrations of salt or other chemical compounds. If it is suspected that ground waters are contaminated with acids or bases in excess of standards, or if the proper conductivity of the electrolyte exceeds 10,000 $\mu\text{S/m}$ (e.g. high salt concentrations), the water from the excavation must be tested. In order to perform the ground water sample tests, they must be delivered to the BENFELT Distributor in a clean non-breaking container. Upon performance of tests, a report is drawn up, stating the degree of water contamination and its impact on the properties of standard BENFELT as well as potential special installation recommendations (e.g. selection of proper mat type). It must be, however, noted that due to modification with proper polymers of bentonite used for production of the BENFELT, the mat is highly resistant to impact of aggressive environments. In the case of performance of horizontal insulation on soil ground or a layer of aggregate with high calcium concentration, it is recommended to use BENFELT CS or lay the mat on a layer of lean concrete. Using filling with high calcium content in direct contact with the mat is not recommended.



Accessories for BENFELT Bentonite Liners



BENFELT PASTE is a bonding and sealing compound made from a combination of bentonite and an anioactive detergent which acts as an emulsifier. The main feature of Benfelt Paste is its high elastic adhesive power. Due to the chemical composition of bentonite Benfelt Paste can expand by up to 90% of its initial volume when it comes into contact with water.

BENFELT STRIP can be used for the sealing of expansion joints in the building and engineering world. BENFELT Strip bentonite sealing strip is a bentonite based elastic compound which has been specially developed by BENFELT to seal water-resistant joints, expansion joints and dividing gaps. It is used to create an impermeable barrier against water and is pressure resistant.



BENFELT RAIL is a galvanised wire grid specifically designed to prevent the displacement of Benfelt Strip during the concrete pouring process.

