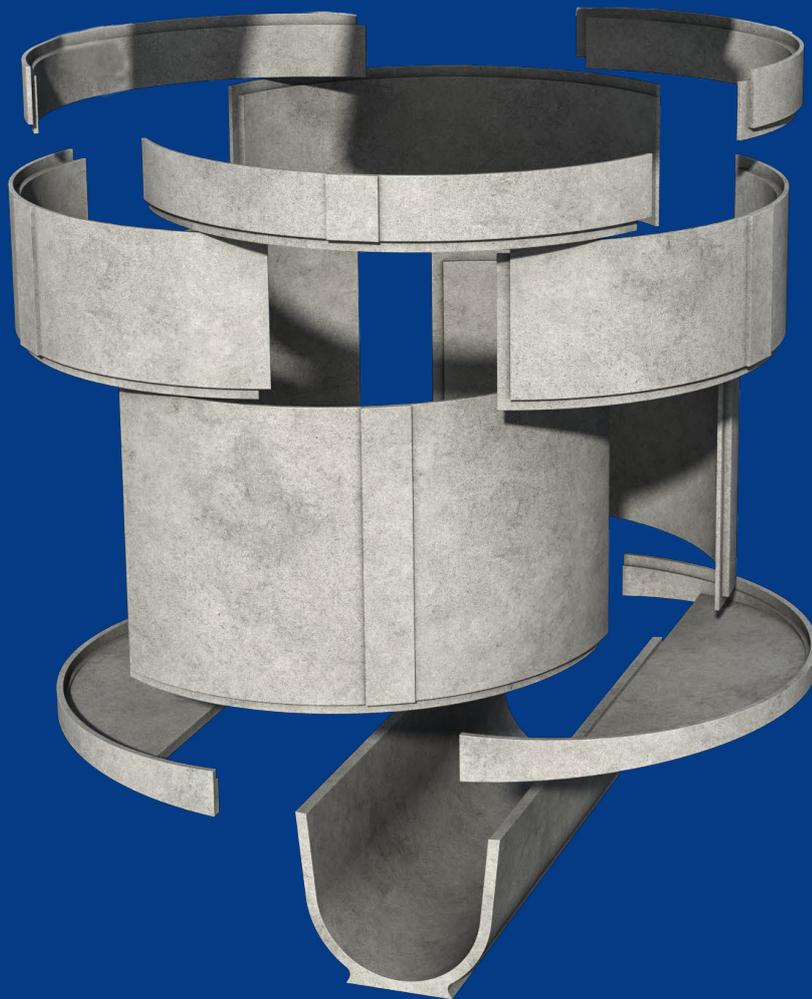


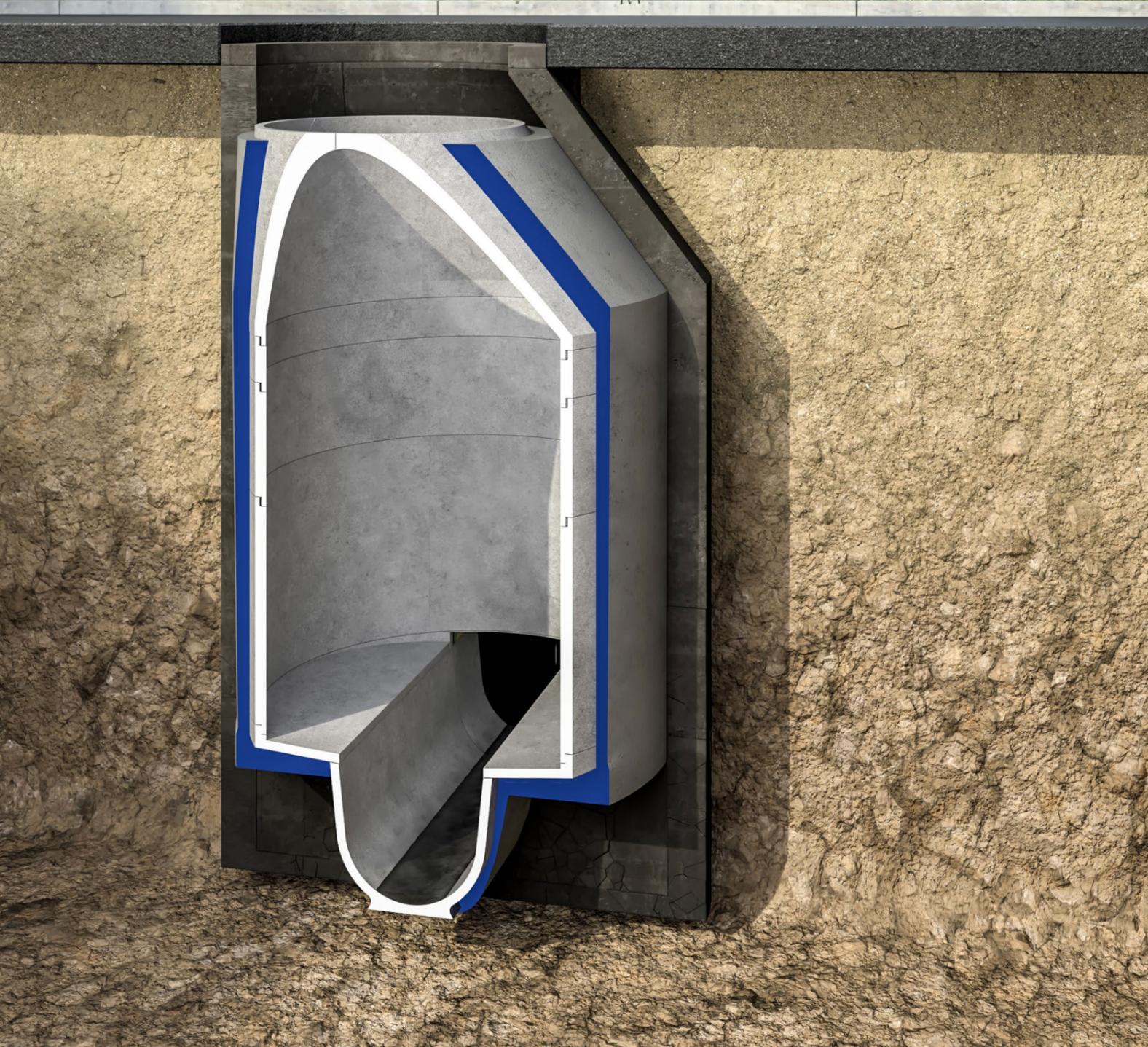
DURA.PORT INSTALLATION MANUAL



FAST, EASY AND EFFICIENT MANHOLE
RESTORATION & REFURBISHMENT SOLUTION



THE ENTIRE
REFURBISHMENT
IS COMMONLY
COMPLETED IN
JUST A DAY



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GENERAL GUIDELINES

This manual provides guidelines for the rehabilitation of DN1000 manholes with DURA.Port elements. The manual intends to provide the user with an overview of the most critical steps during the installation phase. The manual takes into consideration the conditions that are usually present on the construction site. Deviations from the standard modus operandi or project-specific challenges should be discussed with the supplier.



SAFETY

The necessary precautions should be taken to ensure the safety on the construction site. The required personal safety equipment has to be taken into consideration to protect the person in and around the manhole and especially for entering the existing manhole. The application of the safety regulations for working in confined spaces need to be taken into account, as well as all safety regulations for the use and application of the products discussed later in this manual such as epoxies, mortars, etc.

If adaptations to the DURA.Port panels are required on-site, a suitable cutting device will be used. The user needs to apply the correct safety measures (gloves and FFP2 mask) to ensure a safe handling of the DURA.Port panels.



MATERIALS

The delivery will include the following elements, assuming a full rehabilitation including the invert, manhole walls, conus or cover slab is performed:

- **DURA.Port invert piece(s)**
- **DURA.Port berm pieces**
- **DURA.Port ring segments**
- **DURA.Port conus or cover slab**
- **DURA.Glue** – 2-component epoxy to connect elements
- **DURA.Repair** – repair mortar for existing infiltrations
- **DURA.Mortar** – backfill mortar to fill gap between DURA.Port and existing manhole

Apart from the above materials, other material is provided and prepared by the contractor. These materials include typically materials for the fixation and alignment of the elements and/or mortar.



PRELIMINARY ON-SITE ACTIONS

MANHOLE ASSESSMENT

It is recommended to first perform an inspection of the manhole in order to select the required actions for the renovation. Damages and infiltrations need to be charted, as is the case with blockages of the system. Debris or blockages have to be removed before installation.



MEASURING THE MANHOLE STRUCTURE

Before starting rehabilitation work with DURA.Port, the degree of deviation from the perpendicularity and the minimum internal diameter of the existing structure needs to be measured.

A 3D scan is recommended to ensure that the DURA.Port elements provided to the job-site have the correct dimensions and geometry. Additionally, the aim of the 3D scan is to register deviations from the straightness in the vertical structure of the existing manhole. A model can be provided to the client on request, along with the installation order of the panels.



HANDLING & STORAGE

The DURA.Port panels are delivered on pallets or in boxes, depending on the required elements. It is of great importance to ensure that they are placed on a level surface and stored in a dry environment to avoid damage to the DURA-Port elements.

As an option, the elements can be prefab outfitted with connection holes and/or prefab cut to size for easier manipulation, based on the 3D scan. Should minor deviations still occur on the jobsite due to alignment, the panels can be adapted on-site dry cutting. The number of customized DURA.Port cover panel pieces depends on the requirements of the specific project. When wet cutting, it is essential to dry the elements with an absorbent cloth to ensure a clean surface and good adhesion.

The DURA.Glue (2-component epoxy glue) and DURA.Repair (fast hardening repair mortar) will be supplied in buckets/cartridges and should be kept dry and at room temperature.



INSTALLATION INSTRUCTIONS

DURA.PORT INSTALLATION IN 6 STEPS

1.

PREPARATION OF THE EXISTING MANHOLE

The following preparation works usually have to be conducted before the start of the installation of the panels:



BY-PASS

- Close of the inflow of the water to the manhole
- Pump the (waste)water over a sufficient distance to avoid a backflow into the manhole
- Ensure that connections to the manhole are non-operational and/or closed off

CLEANING

- Clean residual deposits and/or obstacles in the manhole
- Remove any climbing anchors and/or ladders in the existing manhole
- If the existing manhole has suffered from H₂S degradation, it is recommended to remove the degraded layer
- If the reinforcement of the concrete is visible, a concrete repair is recommended before installation of the DURA.Port elements

INFILTRATIONS

If infiltrations are present, it is recommended to fix the infiltrations with the DURA.Repair mortar.



DRILLING/CRUSHING

To ensure that the invert element will fit, a check of dimensions needs to be performed. If required, the existing invert needs to be drilled open to ensure a good alignment between the new DURA.Port invert and the existing connections to the manhole.

The necessary safety precautions must be taken into account when operating the drill to guarantee the safety on-site.

The drilling must be done to a depth that guarantees the inflow and the outflow are at the same level after the new invert elements are installed. It is important that the berm plates are supported with the required gradient.

Depending on the material and condition, this may also require drilling work in the area of the berm. Additional space for a mortar bed of at least 40 mm should be provided for correct alignment of the polymer concrete elements. For lateral inlets, proceed in the same way and ensure that the cutouts in the polymer concrete invert elements are made to fit as accurately as possible.

2.

INSERTION OF DURA.PORT ELEMENTS IN THE MANHOLE



The necessary safety measures must be observed during insertion of the elements into the manhole. It is recommended to use a small crane to lift all panels inside.

3.

INSTALLATION OF THE DURA.PORT INVERT ELEMENTS

DURA.Port invert pieces can be provided for rehabilitation of the existing invert. Care needs to be taken that the continuity of invert remains after installation. If multiple invert pieces are required due to extra connections or bends, project specific installation instructions can be provided on request, which will include a lay-out plan of the different pieces.

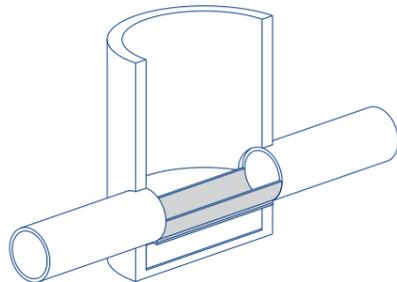
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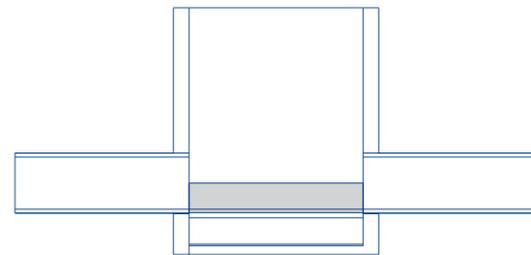
ALIGNMENT OF THE INVERT ELEMENTS

To ensure a good connection to the existing bottom connections, the alignment of the DURA.Port invert pieces needs to be verified before installation of the piece. The new invert pieces need to be aligned with the existing invert connections that enter and/or exist in the manhole to ensure the continuity of invert after installation.

SIDE VIEW



FRONT VIEW



Individual channel designs (e.g. angled or branched) or lateral inlets from one or more invert elements can be cut on site if required. The joint gaps to the inlet and outlet should not exceed 10 mm.

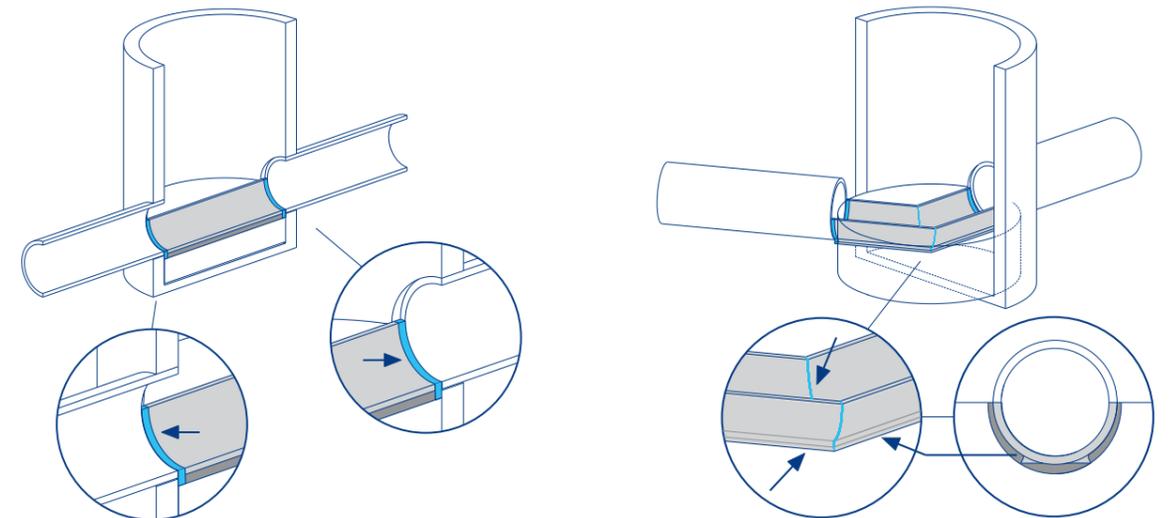
2.

FIXATION OF THE INVERT ELEMENTS IN MORTAR BED

To ensure the stability of the new invert, the piece will be placed in a mortar bed. It is recommended that the mortar bed has a thickness greater than 40 mm to ensure a good stability of the DURA.Port invert piece and ensure that all channel parts are fixed and can no longer be displaced. Care needs to be taken that no air is trapped in the mortar bed.

FIXATION BETWEEN INVERT ELEMENTS AND EXISTING CONNECTIONS WITH DURA.GLUE

The openings between the DURA.Port element and the existing connections will be sealed off with DURA.Glue or a similar resistant mortar or epoxy before any backfilling can be performed. For bigger gaps, a shortliner or equivalent technique can be considered. If multiple invert pieces are required, the elements will be connected with DURA.Glue or a similar resistant mortar or epoxy.



Note: if multiple DURA.Port pieces are required for the invert rehabilitation, the pieces will be glued together using the DURA.Glue epoxy to ensure the new system is watertight. Before applying the DURA.Glue, care must be taken that the area where the glue will be applied is dust-free.

4.

INSTALLATION OF THE DURA.PORT BERM ELEMENTS

The alignment of the berm elements is critical to the alignment of the entire new manhole, as it will influence the vertical straightness of the total system in the next steps. Care has to be taken to ensure a good alignment with both the invert piece and the ring segment elements to ensure a smooth installation.



ALIGNMENT OF THE BERM ELEMENTS

To align the berm elements, use spacers, wedges or adjustment screws to position the DURA.Port element in place. The elements have an internal slope of 3° to ensure all water flows towards the invert. Note that this means that this area should not be placed level. The reference for the level should be the vertical joint connection, as this will decide where the following elements will be placed upon.

Check the correct position of the elements in the manhole as well as the correct diameter resp. the effective annular space with a total outer diameter of the elements of approx. 960 mm.

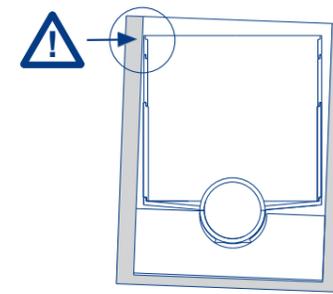
To verify the alignment, it is recommended to enter the 10 cm vertical DURA.Port ring segment elements in the manhole and place them in the folded joint as a way to easily check the alignment. The alignment is correct if a complete circle can be created with the ring of DURA.Port elements.

Furthermore, project specific installation instructions should be followed if additional remarks are present. These additions might be present due to vertical deviations in the existing manhole that need to be compensated during the placement of the DURA.Port berm elements.



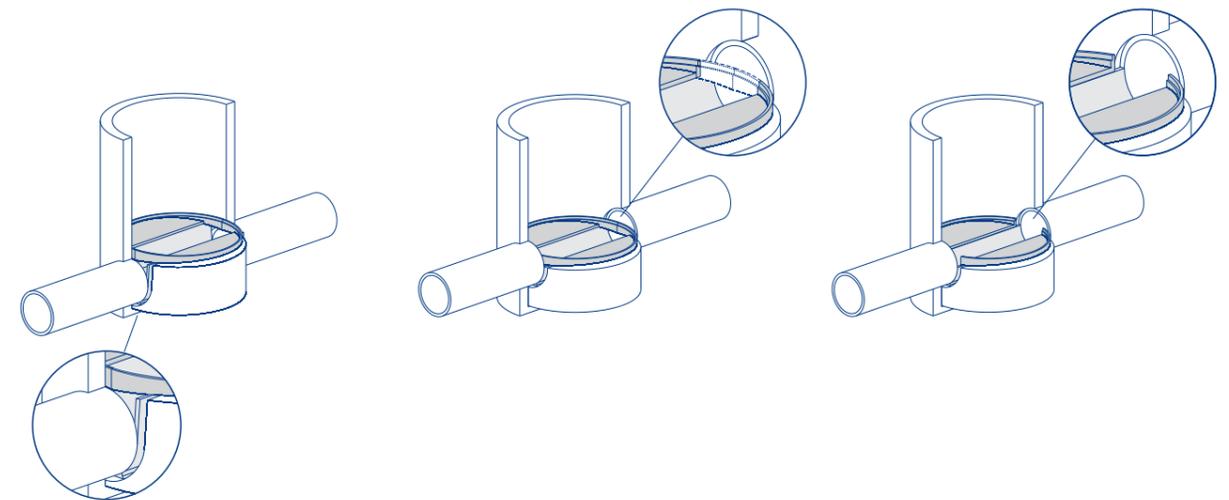
Note: in case berm elements need to be cut on the jobsite:

1. Once you have determined the correct alignment, next mark the projection of the berm half plates into the previously made channel (from below with a clearly visible marker)
2. Cut the plates to size with a suitable tool (see material list).
3. Repeat the alignment with the pre-cut elements and again set up the first row of segments (if necessary with wedges or spacers against the old manhole wall to fix them in place). Make sure that the vertical joints of the segment elements do not sit above an inlet or outlet, if possible.
4. Now check the horizontal alignment using a spirit level and check the accuracy of the fit again. Determine by marking, in which position the berm plates and the first segment row have to be bonded.



Note that in depending on the berm height, inlets or outlets might be blocked. At these points, the elements need to be cut to ensure that the connections remain open and accessible. If the berm is not blocking any inlets or outlets, the berm covers the complete circumference of the manhole, which allows for an easy alignment

Note: this step is the most critical step in the process. It is mandatory to critically check the alignment both in the vertical and horizontal dimensions.



FIXATION OF THE BERM ELEMENTS

1. In order to fix the berm plates in place which were cut in the previous step, mix a suitable mortar and spread it in piles on the existing berm. For a full mortar bed, it is recommended that the mortar layer has a minimum thickness of 40 mm to ensure the stability of the DURA elements. In addition, mix epoxy resin according to the manufacturer's instructions and apply it sufficiently to the edges of the installed invert element.
2. Make sure that enough adhesive is applied at all points to prevent leaks between invert element and berm half plates, in order to prevent backfill mortar from leaking into the channel. Before applying DURA.Glue, care must be taken that the area where the glue will be applied is dust-free to ensure a good adhesion to the surface.
3. In the next step, align the segments of the berm half plates with the help of a rubber hammer, spacers (wedges) and a spirit level.

Leaking adhesive between berm half plates and manhole channels indicates complete backfilling and can be removed mechanically with a trowel or other suitable tool and spread cleanly at the joint edges.

Tip: the access to the new berm plate can be sped up if a fast-hardening mortar is used for this step.

5.

INSTALLATION OF THE DURA.PORT RING SEGMENT ELEMENTS



After installation of the berm elements, one can easily install the DURA.Port ring segments on top for the full remaining height of the manhole. Each row needs to be aligned on the folded joint contact surfaces of the previous row and glued to the existing structure to ensure the watertightness of the system.

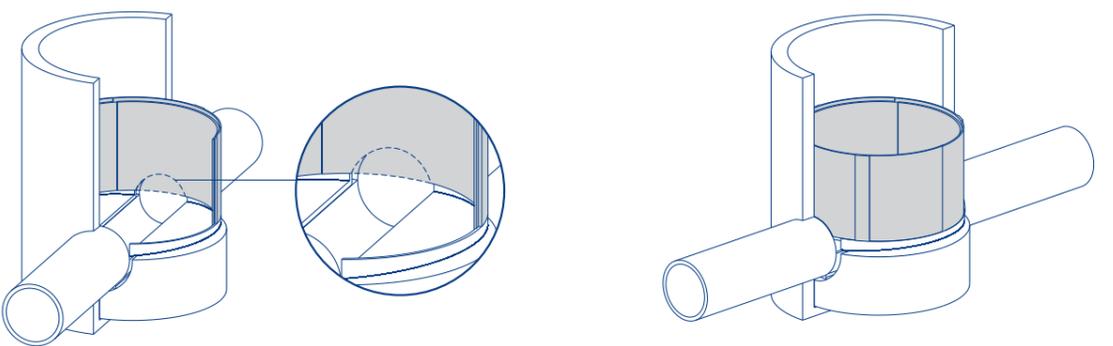
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ALIGNMENT OF THE RING SEGMENT

If the DURA.Port berm elements have been installed following the instructions in the previous chapter, a complete ring of wall segments can be formed on top of the berm elements, as shown by the control during the alignment with the ring segment row of 10 cm.

Additional ring segments can be created in a similar way by installing the new ring on the folded joint of the previous ring. If the segments are located in the area of inlets or outlets, mark the opening on the segments and cut it out as accurately as possible in advance using a suitable tool (e.g. angle grinder or cutter).

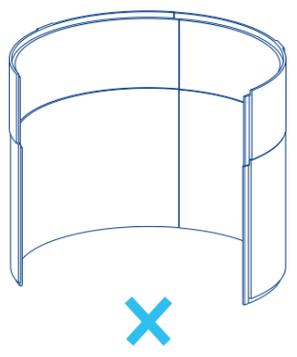
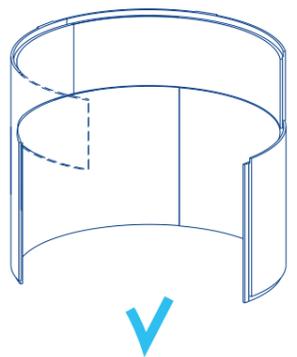
Note: for the installation case where the berm is located at half the height of the connection, half of the connection will be covered by the the first row of ring segments In this case, the element has to be sawn on-site before fixation of the elements. To install these elements, bring the elements in first, mark the spot where the connection is located and bring the panel out the cut the panel.



Spacers or wedges can be used between the existing wall and the new elements to align the panels correctly.

The DURA.Port ring elements should be installed out-of-phase in relation to each other:

FRONT VIEW INSIDE



The last ring segment row will need to be cut-to-size on site, depending on the alignment. After measurement of the required height, the last ring segment row is taken out of the manhole and cut on site. Care has to be taken that the required safety measures are taken.

To decide on the final height, it is recommended to leave an open space between the existing cover slab and the top of the last wall segment row of ± 5 cm in case of non-conus manholes. In that way, the DURA.PORT cover slab piece can be installed used the mortar-in-mortar method.

2.

FIXATION OF THE RING SEGMENT WITH DURA.GLUE



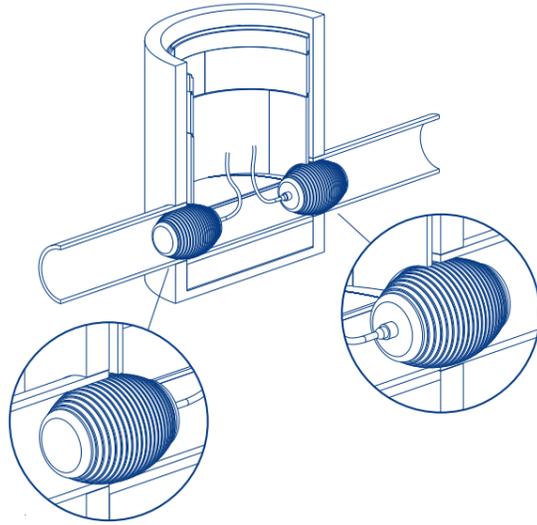
All joints between the ring segments shall be connected with DURA.Glue to ensure a watertight and robust system. Before applying the DURA.Glue, care must be taken that the area where the glue will be applied is dust-free.

For the connection between the first ring segment and the berm joint, the connection is made in a similar way.

3.

BACKFILL BETWEEN THE RING SEGMENTS AND THE EXISTING MANHOLE

Before the backfilling can start, any relevant connection should be closed with a balloon to avoid intrusion of the mortar into the sewer system.

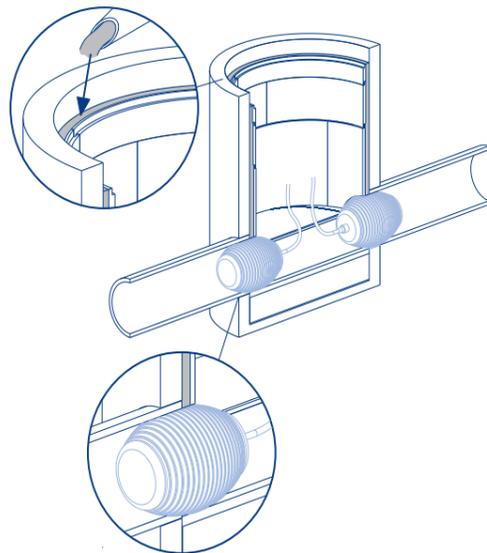


1. Backfilling with DURA.Mortar:

It is recommended to do a backfilling after the first meter with DURA.Mortar to create a strong, stable foundation for the subsequent elements. Care needs to be taken that the DURA.Glue epoxy in the joints and connections is fully hardened before backfilling is performed. By using DURA.Mortar no extra chemical protection of backfilling mortar (e.g. hand laminate or epoxy) is necessary.

2. Backfilling with standard "Dämmer" or "Grout":

For preparing the backfill material, follow the instructions of the supplier. The backfilling is done between the existing manhole wall and the new DURA.Port ring segments. Filling or pouring is done manually (bucket) or with a pump under low pressure (static height).



When the backfill material is completely hardened, the balloons can be removed. If a chemically resistant backfill material is used, no further actions are required. If a non-resistant backfill material is used, ensure that all the backfill surfaces are covered with DURA.Glue or an equivalent chemically resistant material to avoid any future damages to the system.

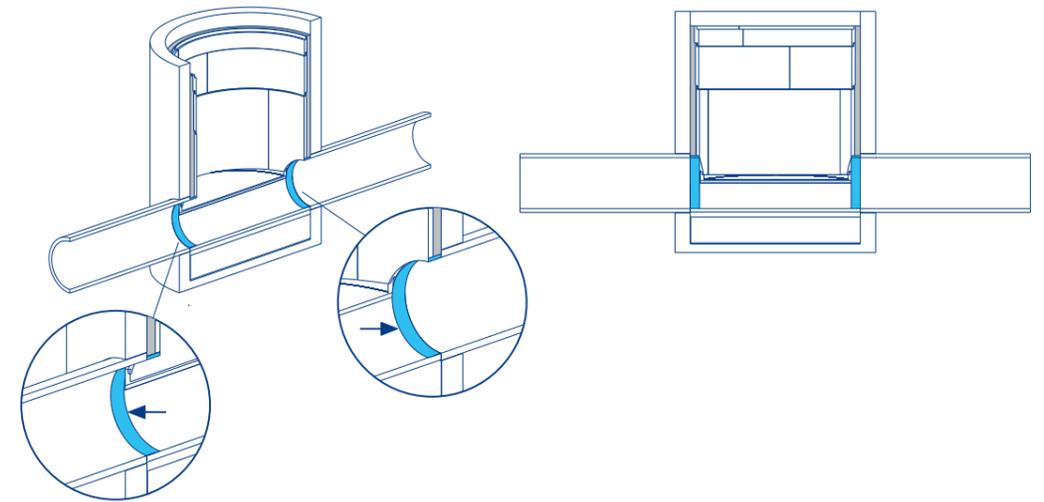
4.

CONNECTIONS ABOVE THE INVERT LEVEL

If the segments are located in the area of inlets or outlets, mark the opening on the segments and cut it out as accurately as possible in advance using a suitable tool (e.g. angle grinder or cutter).

Ensure that connections above invert level are well aligned to ensure a smooth transition between the existing connection and the new DURA wall element opening.

Before backfilling, it is required to close off the annular gap between the existing manhole and the new DURA.PORT manhole. This can be done with a fast-hardening mortar or with a short piece of pipe or liner.



5.

LAYER-BY-LAYER BACKFILLING

Backfilling can be performed under similar conditions as the first backfilling. After hardening of the backfill material, care needs to be taken that the whole backfill surface inside the connection is covered with DURA.Glue to avoid any degradation of the material.

The vertical wall elements that are provided for the jobsite will ensure an installation up to +/- 10 cm from the cover slab. In this way, it is still possible to backfill through this gap.

Tip: it is recommended to backfill the system at least every meter to ensure a smooth installation.

OPTION 1: INSTALLATION OF DURA.PORT COVER SLAB PLATES (FOR MANHOLES WITHOUT CONUS)

ALIGNMENT OF THE DURA.PORT COVER SLAB PLATES

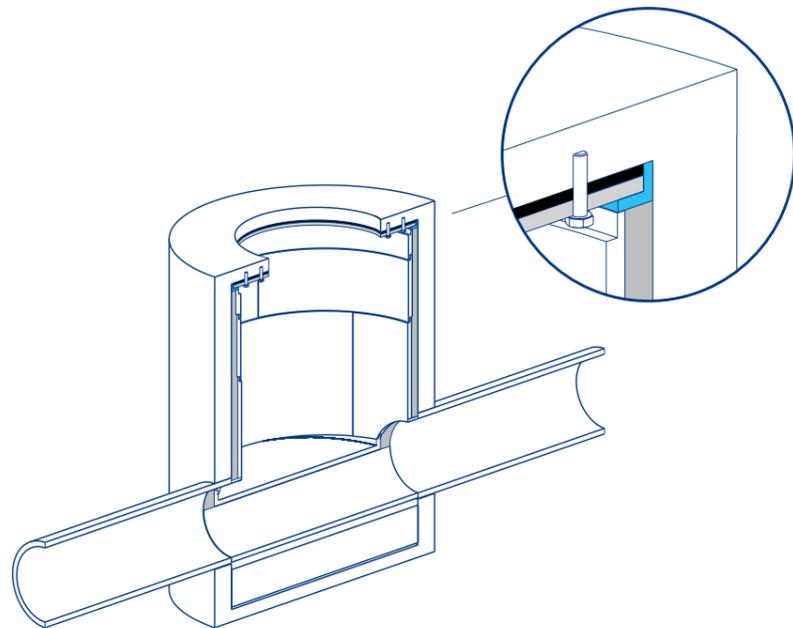
If available, the project-specific installation instructions need to be applied during the installation of the cover slab plates. The elements can be placed upon the existing ring segments to help with the alignment of the system.

FIXATION OF THE DURA.PORT COVER SLAB PLATES IN MORTAR

The DURA.Port cover slab can be aligned with the last row and can be directly fixed against the existing cover slab with the mortar-in-mortar method. It is recommended that the mortar bed has a thickness greater than 40 mm to ensure a good stability of the DURA.Port cover slab pieces. Care has to be taken that the entire area is covered and that there are no holes in the mortar bed.

It is recommended to mechanically fixate the cover slab pieces by means of a mechanical anchor into the existing cover slab, to ensure a stable new cover slab.

The open space between the new cover slab piece and the wall segment need to be filled with DURA.Glue. Care needs to be taken that all gaps are covered with DURA.Glue.



OPTION 2: ALIGNMENT AND FIXATION OF THE CONE ELEMENT (FOR MANHOLES WITH CONUS)

The segment rings should end about 5-10 centimeters below the old cone. Use the different heights of the segment elements (100, 250, 500 mm) to minimize the need for adjustments to the components.

The DURA.Port cone element consists of four parts, each of which has a folded connection to the segment rows. For lining, observe the following points:



1. First mark the center of the slope and the straight line of the existing cone part before you put on the new cone.

2. Apply sufficient adhesive to the uppermost folded joint of the segments as well as to the fold of the two inclined cone parts and the vertical joint between these two cone parts.

3. Then initially set up the inclined cone parts using the marking. Anchor them in the old manhole wall using suitable means, if necessary.



4. Next, glue the two smaller, straight parts on all sides to the polymer concrete elements that have already been placed.

5. Fix the cone against the old manhole wall to secure the position, e.g. by using spacers.

Make sure to insert and glue all four cone parts at an opportune time. Correct alignment is only possible with all four parts in the not yet glued state. Therefore, work carefully, because a correction is no longer possible after the adhesive has cured.

All cuts should be cleaned and dried before applying the adhesive.

Tip: the fourth and final cone element that needs to be installed can be cut diagonally (e.g., with dimensions a 100 mm and b 200 mm) to facilitate the installation. Start by inserting element b, and then insert the last cone element a from the top using a rubber mallet.

Note: the work should be done quickly to ensure that the adhesive is still flexible, allowing the other cone elements to be adjusted if needed.



BACKFILLING OF THE REMAINING ANNULAR SPACE

After the adhesive has cured, fill the annular space up to the upper edge of the cone element with a suitable filling mortar in the same way as in the previous steps.

Use a suitable method to ensure that the unprotected filling mortar does not come into contact with the wastewater at any point. In the area of inlets and outlets, this can be done, for example, with synthetic resins, hand laminates or internal sleeves. The transition between the upper edge of the new cone and the lower edge of the manhole cover can be made, for example, with a manual coating of wastewater-resistant mortar. Alternatively, the space can be backfilled in layers up to the top edge by means of a ring bladder and sealed with suitable coating methods.

END OF WORKS

REMOVAL OF RESIDUES

Glue or mortar residues outside of the folded joint needs to be removed/cleaned before reopening the sewer system.

VISUAL INSPECTION ON JOINTS

After the hardening of the mortar, the new manhole is checked for any gaps. If any gaps are spotted, DURA.Glue can be used to make the system watertight.

RE-OPENING OF THE SEWER SYSTEM

All material should be removed from the manhole before the inflow can be restarted.





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