

FRANK | Zemdrain®

Technical application guidelines



Summary of Contents

General information	47
Formwork	48-49
Tensioning and fixing Zemdrain® to the formwork	50-54
Adhesive tapes	55
Staples	56
Spacers	57
Zemdrain® formwork joint	58
Tie bars	59
Damages	60
Concreting	61
Compaction	62
Disposal and health aspects	63
Handling formwork liners	64-65
Fixing details Zemdrain® MD	66-77
Fixing details Zemdrain® Classic	78-87

For best results

To obtain the best results with Zemdrain[®], the following should be observed:

These Guidelines are a condensed description of factors having a direct effect on the performance of Zemdrain[®] CPF Liners and are based on the present state of the art. It may be necessary to alter these recommendations, as more information becomes available. If in doubt please consult your local supplier.

Please note: Zemdrain[®] cast concrete will generally be slightly darker than traditionally cast concrete reflecting the colour of the cement and the enhanced curing effect of the liner.

1. Formwork

1.1 General

The finished concrete surface produced by Zemdrain® will be a reflection of the formwork used. For aesthetic applications the use of brand-new elements is recommended. The form face should be continuous, flat, clean and oil free. With lower grade plywood, the face should be sealed to prevent water ingress and extraction of wood sugars. Tape any joints where oil may have concentrated.

1.2 Appropriate formwork elements

All types of formwork elements can be used with Zemdrain®, but the method of installation may vary. Plywood and timber faced forms are the most suitable for use with Zemdrain®. Steel and plastic faced forms can also be used but they require special fixing methods. Monolithic circular steel forms can be lined in one operation using a specially adapted roll of Classic (details available upon request).

For all applications please consult your local supplier or our technical department if you have any queries.

1. Formwork

1.3 Release agents

Release agents should not be applied to the formwork or to Zemdrain®.

Take care to avoid all contamination. Where release agents have previously been applied to the form face, this must be removed prior to Zemdrain® installation. This can be achieved by cleaning vigorously with a cloth and then jet washing or alternatively by sprinkling cement onto the surface and after the reaction has taken place brushing the residue off.

1.4 Formwork preparation

If the form face has visible raised nails, gaps or height differences between panels, old tie bolt holes, other defects or is not clean, then unless remedied these will be reflected on the finished concrete surface. Precautions should be taken to avoid any contamination of the surface of the installed Zemdrain® liner. Joints between formwork elements to be lined with Zemdrain® must not exceed dimensions $\geq 1 - 2$ mm. Any joints in excess of 2 mm should be sealed using an adhesive tape.

2. Tensioning and fixing Zemdrain® to the formwork

2.1 General

Zemdrain® requires tensioning over the formwork face to ensure that the liner does not move during concrete placement. The applied tension should be sufficient to allow for the expansive nature of the polypropylene and for any creep or relaxation that may occur. We recommend that where possible tensioning is performed during the warmest part of the day as the liner will expand/contract when exposed to and shaded from the sun. The warmer the product the easier it is to tension. **Lined forms should be protected from direct sunlight and from prolonged cycles of warming and cooling. For erected forms in direct sunlight, these should be allowed to cool down prior to concreting.** Formwork should be erected in the normal manner. It is important that all assembled forms are held rigid to prevent unnecessary stress to the liner which may cause a reduction of applied tension.

2. Tensioning and fixing Zemdrain® to the formwork

Please note: In times of high daily/weekly temperature variations ($> 10^{\circ}\text{C}$), care is required to ensure that the liner remains under the correct tension and folds are not formed. **This phenomenon enables you, however, to cover and fix the formwork during warm periods of the day and to proceed with concreting when it gets colder.** If the specially designed fixing accessories are not used there is an increased risk of fold formation. When using Zemdrain® at low temperatures or with heated concrete, it is recommended that the liner be kept in a warm environment prior to use and that additional rows of staples be added at 1.0 m intervals over the form height.

It is recommended that as short a time as possible is left between tensioning and first concreting (max. 3 days). The tensioned material will relax with time and if the correct tension is not applied this can lead to fold imprints on the concrete. For longer periods of exposure the maximum tension should always be applied to the liner.

2. Tensioning and fixing Zemdrain® to the formwork

2.2 Why tension?

- Using Zemdrain® without any tensioning or insufficient tensioning will lead to the liner being folded by the rising concrete causing fold imprints in the finished concrete surface.
- Pre-tensioning is also necessary in order to minimise dimensional changes caused by warming such as due to direct sunlight or the heat of the concrete.

Zemdrain® is a polypropylene based liner and thus has thermal expansion properties. Creep and relaxation processes can cause permanent elongation of up to 0.15 %. It is always advantageous to carry out tensioning work under the influence of the warmth of the sun or using artificial heating methods. Tensioning is critical to the successful use of the liner and we strongly recommend that our specially developed fixing accessories should always be used.

2. Tensioning and fixing Zemdren® to the formwork

2.3 Important recommendations

Wherever practicable, rolls should always be fixed with the length direction of the roll in the vertical pour direction. A tensioning force of approximately 1.00 to 1.50 N per metre is needed which can only be applied using our special fixing accessories.

Stretching by approximately 0.3 to 0.6 % (equivalent to 3 – 6 mm/metre – depending upon the air temperature) is required for the lengthwise direction of the roll.

Stretching by approximately 0.1 to 0.3 % (equivalent to 1 – 3 mm/metre – depending upon the air temperature) is required in the crosswise direction of the roll.

2. Tensioning and fixing Zemdrain® to the formwork

2.4 Erecting the formwork

It is recommended that if possible the work process should be organised so that the Zemdrain® lined forms are the last to be erected. This prevents unnecessary damage or prolonged exposure to cycles of warming and cooling. Forms should be erected as soon as possible after lining. As with all formwork, special attention should be paid to sealing of the formwork joints and to sealing the joints between kickers and the form or to base slabs and to preceding concrete pours.

The Zemdrain® prefixing tape and foam plastic waterstop have proved useful for this purpose, as have suitable cartridge sealing materials. Take care to ensure that water drainage from the rear of the Zemdrain® remains unimpeded. The ends of the liner should always be outside the pour.

3. Adhesive tapes

For special applications only

Due to adhesion problems caused by heat, humidity, rain or contamination, tapes should only be used for special applications (steel formwork, precasting plants, etc.).

We cannot accept liability for insufficient adhesion of these adhesive tapes on formwork and Zemdram®.

In addition, use of the adhesive tape impedes outflow of the air and drainage water and this can cause isolated small blowholes on the concrete surface.

Zemdram® tapes and other adhesive tapes do not have specific approval for their use in the construction of drinking water reservoirs, please check with local regulators regarding suitability for use.

4. Staples

Only use stainless-steel staples of the correct size.

Only use stainless-steel staples of the correct size.

Staple sizes of 8 to 12 mm are appropriate depending upon the grade of Zemdrain® used and the hardness of the supporting plywood.

Protruding staples must be hammered home, otherwise they may remain in the face of the concrete.

5. Spacers

Reduction of visible imprints and load distribution



To avoid visible marks on the concrete surface, at tie bolt holes and under spacer blocks the maximum pressure on Zemdrain® should not exceed 2 MPa (20 kg/cm²).

Loading caused by reinforcement should be distributed onto as many spacers as possible.

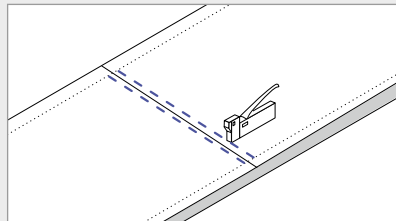
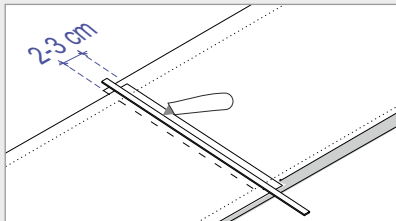
We recommend the use of high quality fibre concrete spacers, distance tubes and stoppers. These should have the same compressive strength, durability properties and other characteristics as required of the concrete.

6. Zemdrain® – formwork joint

Joints between liners

Where butt-joints are unavoidable on the formwork face, the two strips should be overlapped by approx. 2 – 3 cm. Then both strips should be cut through together along one line and the off-cuts removed.

Both Zemdrain® formwork liners must butt together and they must be fixed with staples. Staples should be positioned parallel to the cut edge for optical reasons.



7. Tie bars

After fixing Zemdrain® to the formwork



Tie bolt holes should only be made after Zemdrain® has been fully tensioned and fixed to the formwork.

To form tie bolt holes make a cross-shaped slit and then form the hole using a blade cutter. For extra safety, a few staples can be used to secure the liner in place at the locations.

8. Damages

Repairs are also possible for larger surfaces

Damaged areas should always be replaced. For larger surfaces place a new piece of Zemdrain® over the damaged area and cut through both layers to form an infill section. Remove the damaged liner and replace with the new piece using staples.



For repair of small damaged areas use Zemdrain® double sided adhesive tape.



9. Concreting

In conformity with the usual guidelines

Concrete should be designed, placed, compacted and cured in accordance with accepted good practice and to the usual local guidelines. **If concrete mixes with special cements such as Terrament or micro-silica are to be used, please discuss this with our technical advisory service.**

Concrete should be placed and compacted in accordance with accepted good practice. Pouring and vibration of concrete should be performed consecutively without delay. Ensure that concrete is not discharged against the liner surface, splatter can be minimized by using a tremie tube or pumping. Also, avoid concrete wetting the surface of the liner and then being allowed to dry out. Failure to observe any of the above may result in prominent pour lines, colour variations, segregation or the presence of blowholes. Splashes of cement laitance against Zemdrain® caused by poor placement techniques can completely or partly prevent discharge of air and water through the liner.

10. Compaction

Compaction with an internal vibrator

Primary vibration must be performed using an internal poker vibrator. External vibrators should only be used after completion of the pour and of primary vibration. The vibrator should be kept at a distance of at least 5-10 cm from the form face. Also ensure that fast extraction of the vibrator and excessive and irregular vibration are avoided. Some blowholes and lighter coloured concrete can occur in the upper 5-10 cm of a pour. This can be minimized by re-vibration of this zone (after 20-50 mins), followed by tamping and smoothing of the surface. Another possibility is to surcharge the surface.

Zemdrain® cast concrete will generally be slightly darker than traditionally cast concrete reflecting the colour of the cement and the curing effect of the liner.

Additionally, surface colour variations may also occur due to variable vibration, plywood quality, the mix used and the number of uses of the liner. These colour variations do not effect concrete quality.

11. Disposal and health aspects

Ecologically harmless

Zemdrain® consists of 100 % polypropylene and belongs to the polyolefine disposal category which is ecologically harmless. After carefully removing the used liner and staples from the form face, the liner can be used for protection of or as a drainage fabric on underground walls or beneath floor slabs. If this type of re-use is not possible, then as the liner is chemically inert it can be safely disposed of by burying, earth dumping or incineration. A Material Safety Data Sheet is available upon request.

12. Handling formwork liners

Safety precautions

Opened and unopened rolls of Zemdrain® should be stored in a clean environment, away from contaminants and prolonged exposure to UV light. In cold weather, rolls should be stored indoors. Zemdrain® should be protected from flames, welding or steel cutting and kept free from dirt and dust.

Always wear protective gloves to avoid cuts caused by sharp edges or during cutting work. You should avoid heavy mechanical friction to the concrete side of Zemdrain® formwork liner, as this can lead to separation of the individual surface fibres. The risk of damage to the liner, which can occur when the shutters are being erected can be minimized if the lined shutters are stored vertically.

12. Handling formwork liners



For the latest Zemdrain® MSDS information sheet please download a copy from the Max Frank or Zemdrain® websites or request a copy from our technical department.

For specific handling or technical queries please contact our Technical Department for further advice. Telephone us at

Tel. +49 9427 189-189

See these websites for more information:

www.maxfrank.com · www.zemdrain.com

Fixing details Zemdrain® MD

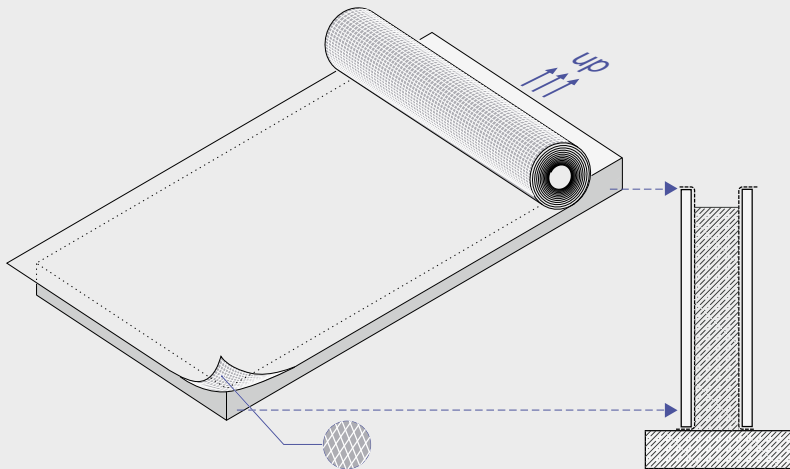
- Forms should be raised off the ground and laid horizontally in both directions to avoid any mis-tensioning of the liner.

Important: Please ensure that forms are sufficiently rigid.

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Fixing details Zemdrain® MD



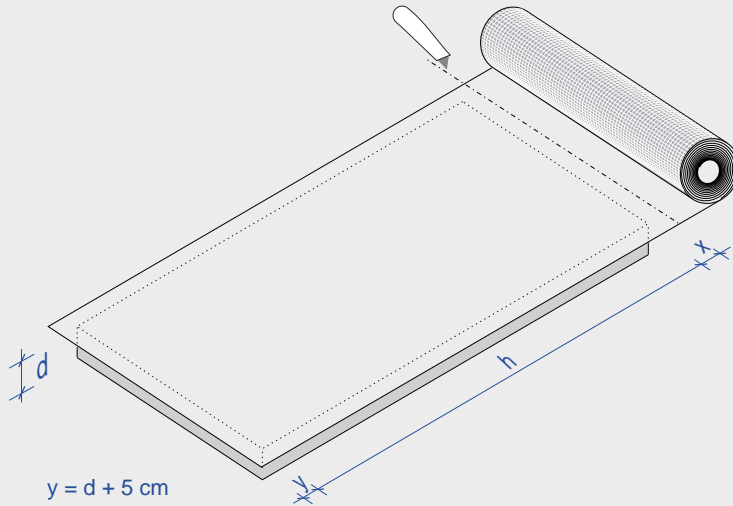
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Fixing details Zemdrain® MD

- Unroll MD and cut to the right size; length = shutter height (or shutter length), $h + y + x$. When using a Tensioning tool: $x = 5$ cm. When using the Tensioning frog or clamp: $x = 25$ cm. Please note that not all types of tensioning accessories are available in every country. For accessory availability please contact your local supplier.
- Leave flat and exposed to the sun for at least 10 minutes to allow the liner to relax and expand.
- Before stapling in position at the non tensioning end, ensure that the liner is lying square on the form.
- **Please note: The smooth white side is the CONCRETE SIDE.**

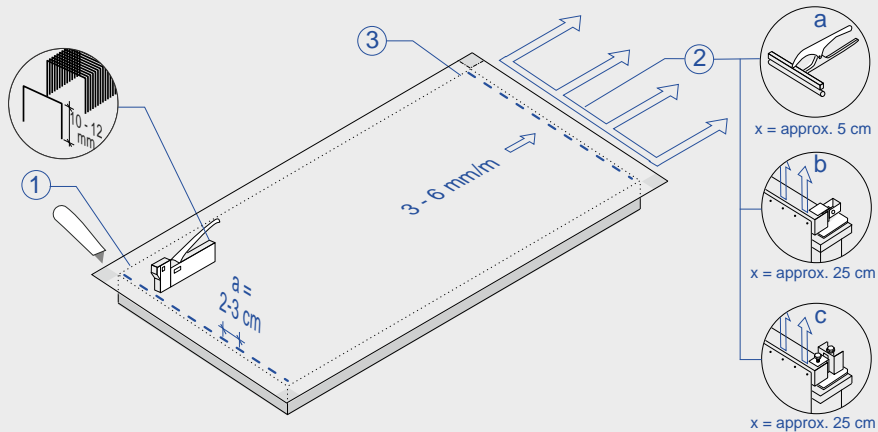
Fixing details Zemdrain® MD – lengthwise direction



Fixing details Zemdrain® MD – lengthwise direction

- Always tension in the length direction of the roll first, which should preferably always be in the pour direction. A tension of 3 – 6 mm / m (depending on the air temperature) should be applied using our special fixing accessories.
- The formwork liner must be tensioned simultaneously over the complete width.
- Lengthways tensioning – before applying the recommended tension take up slack so that liner lies flat on the form.
 - a) Tensioning Tool – used for lengths of up to 2.5 m
 - b) Tensioning CLAMP – used for tensioning length of up to 12 m
 - c) Tensioning FROG – after unlocking it generates a permanent tension (for shutter lengths $L = 2.5 - 5.5$ m depending upon the prevailing air temperatures)
 - d) Stapling in position should be at 2 - 3 cm centres using 10 mm staples.
- Formwork lengths of up to 12 m can be tensioned using our standard tensioning accessories. For greater lengths, please consult our Technical Department.

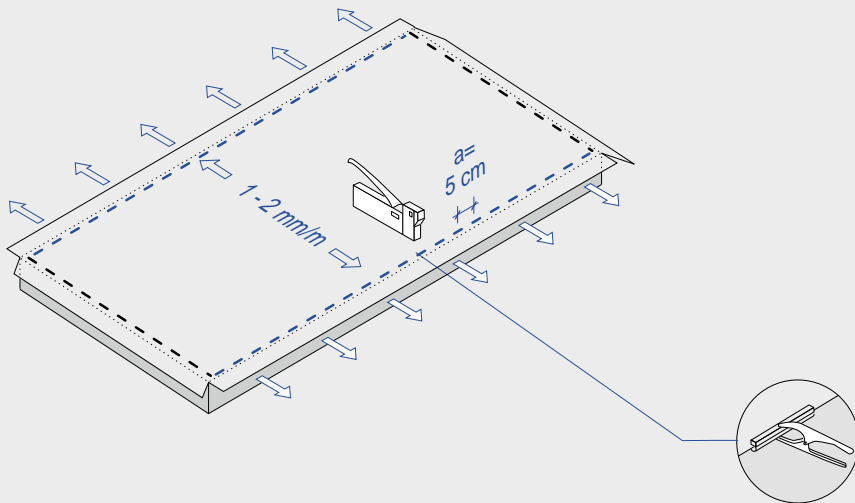
Fixing details Zemdrain® MD – lengthwise direction



Fixing details Zemdrain® MD – crosswise direction

- Crosswise tensioning (elongation of 1 – 2 mm/m) is carried out simultaneously on both sides using a Tensioning tool at intervals of approx. 1 metre, alternating between sides. Stapling in position should be at 5 cm maximum centres using 10 mm staples.
- For optical reasons we would recommend to position the staples parallel to the shutter edge or even better outside the concrete surface.
- If Zemdrain® MD is to be reused and depending upon tensioning method used, it may be necessary to protect the liner against excess elongation during stripping by having additional horizontal rows of staples at 1 metre intervals.
- The liner can now be stapled down at the formwork edge. Alternatively to obtain the most aesthetic joint we would recommend that the grid and the filter be separated and the excess grid cut off, the filter can then be stapled to the edge of the form or held in place with adhesive tape.

Fixing details Zemdrain® MD – crosswise direction



Fixing details Zemdrain® MD

- Alternatively, the following sealing method for MD edges are generally applied:
 1. Fix a foam plastic tape underneath the liner. Tape only on the sides never at the base of the form where drainage would be impeded.
 2. Staple the liner in position.
 3. Seal the edges with the Zemdrain® cover tape.

A tape should not be used at the bottom edge of the formwork as it will impede drainage of the excess water.

- Store formwork as recommended on page 50 and prepare for a second use (where necessary re-tension, replace missing staples, replace damaged adhesive and foam plastic tapes etc.).

Fixing details Zemdrain® MD

- 1** Lengthwise tensioning/
pour direction tensioning.
The formwork liner must be
tensioned simultaneously over
the complete width.
- 1a** Tensioning with tensioning
tool
- 1b** Tensioning with tensioning
clamps



Fixing details Zemdrain® MD

- 2** Crosswise tensioning
- 2a** Crosswise tensioning (extension 1 – 2 mm/m) is carried out simultaneously on both sides using a tensioning tool.
- 2b** Application flush with formwork edge: Where liner is to be cut flush with the formwork edge, a foam plastic tape should be placed under the liner prior to stapling.
- 2c** Application with liner overlapping the edges: In the overlapping part peel the Zemdrain® filter away from the grid and trim the grid in line with the formwork edge.
- 2d** Fix the Zemdrain® filter to the metal edge of the formwork panel using a double-sided adhesive tape.

Fixing details Zemdrain® MD



Fixing details Zemdrain® Classic

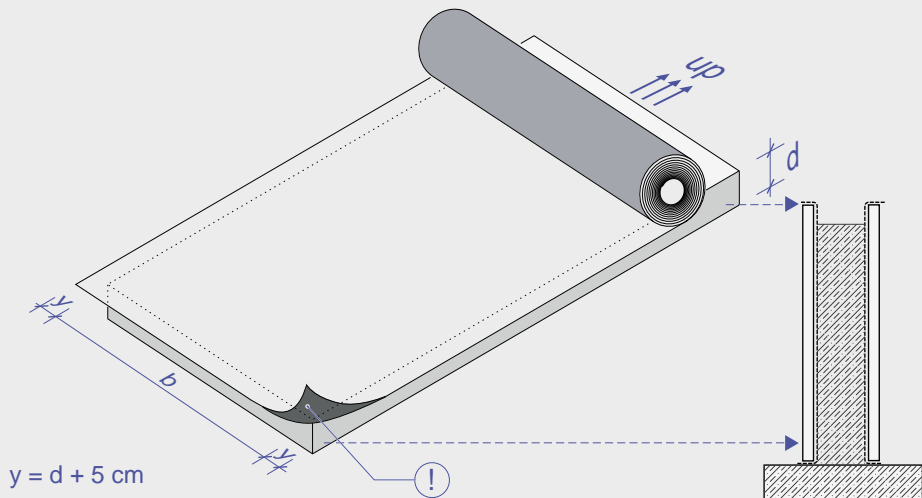
- Forms should be raised off the ground and laid horizontally in both directions to aid tensioning of the liner.

Important: Please ensure that forms are sufficiently rigid.

- Fix tensioning accessories such as tensioning clamps or tensioning frogs to the formwork. Please note that not all types of tensioning accessories are available in every country. For accessory availability please contact your local supplier.
- Selection of roll width =
formwork width + extra width $2y$.
When using tensioning hooks $y = 20$ cm
(depending on formwork thickness d).



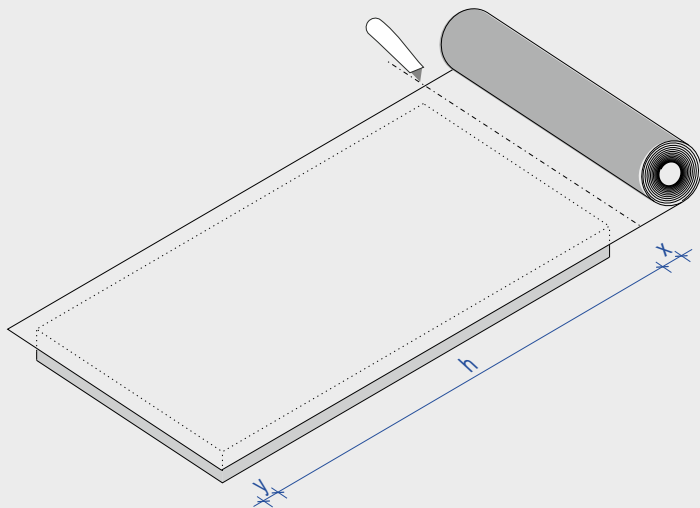
Fixing details Zemdrain® Classic



Fixing details Zemdrain® Classic

- Unroll and cut Zemdrain®, length = shutter height (or length), $h + y + x$.
When using tensioning clamp or tensioning frog. $x = 25$ cm.
- Leave flat and exposed to the sun for at least 10 minutes to allow the liner to relax and expand.

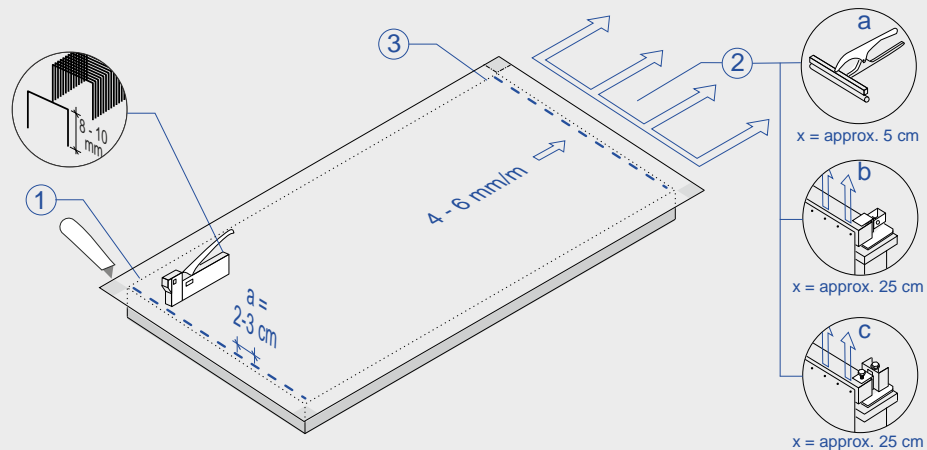
Fixing details Zemdrain® Classic



Fixing details Zemdrain® Classic

- Before fixing, ensure that the liner is square on the form and attach it to the bottom end using suitable staples at intervals of 2 – 3 cm. Depending upon the density of the plywood face, staples of 8 to 10 mm should be used.
- **Please note: Black side to formwork – grey side to concrete.**
- Always tension in the length direction of the roll first, which should preferably always be in the pour direction. A tension of 4 – 6 mm/m (depending on the air temperature) should be applied using our special fixing accessories.
- The formwork liner must be tensioned simultaneously over the complete width
- Formwork lengths of up to 12 m can be tensioned using our standard tensioning accessories. For greater lengths, please consult our Technical Department.

Fixing details Zemdrain® Classic



Fixing details Zemdrain® Classic

- 1 Please note: black side to formwork – grey side to concrete. Stapling in position should be at 2 - 3 mm centres using 10 mm staples.
- 2 Cut out excess material to fit the corners
- 3 Lengthwise tensioning
- 3a Tensioning frog – after unlocking it generates a permanent tension (for shutter lengths $L = 2.5 - 5.5$ m depending upon the prevailing air temperatures)
- 3b Tensioning clamp – used for tensioning lengths of up to 12 m.
- 4 Crosswise tensioning – should be carried out simultaneously and parallel on both sides for tensioning hooks.



Fixing details Zemdrain® Classic

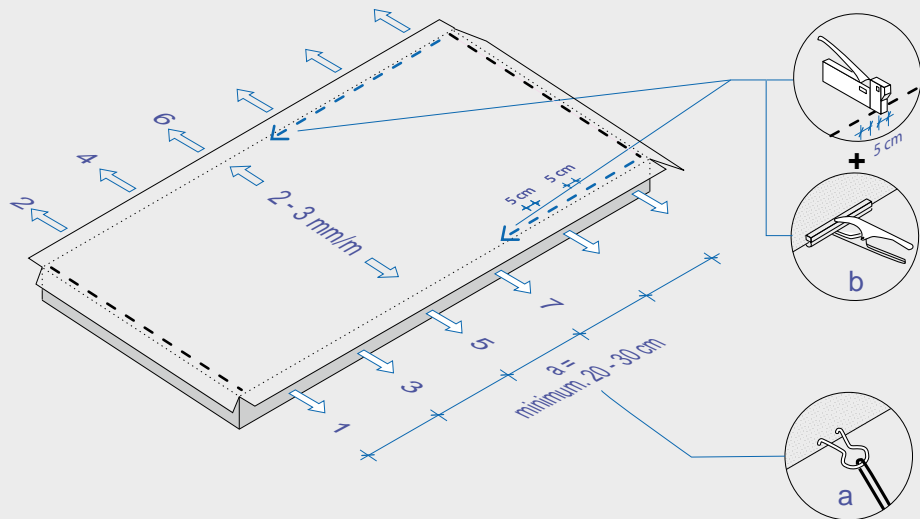


Fixing details Zemdrain® Classic

- Crosswise tensioning (tension 2 – 3 mm/m – depending on the air temperature) is carried out using either a Tensioning tool or Tensioning hooks. For the Tensioning tool apply tension and then staple liner to the form edge or face. For the Tensioning hooks, these should be placed into the Zemdrain® at intervals of at least 20 – 30 cm with double hooks – starting at the bottom of the form and doing both sides simultaneously – and then vigorously pulled upwards (at an angle of 30° – 45°) at the rear side of the shutter.
CAUTION: Take care to fix these hooks correctly to avoid any potential injuries
- Alternatively, crosswise tensioning can also be done using a tensioning tool (staples at maximum intervals of 5 cm).



Fixing details Zemdrain® Classic



Technologies for the construction industry



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This Installation Guideline is a condensed description of factors having a direct effect on the performance of the Zemdrain® controlled permeability formwork liner and is based on the present state of the art. It may be necessary to alter these recommendations, as more information becomes available. Correct use is the responsibility of the user, if in doubt please consult your local supplier.

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