

Passive fire protection system for tunnels



Learn more about SkamoTunnel

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Safe passive fire protection with **SkamoTunnel**

SkamoTunnel is a lightweight system for passive fire protection of tunnels.

The system consists of the SkamoTunnel Board 250 and a range of accessory products.

SkamoTunnel is the safe choice:

- ✓ Weighs 10kg/m² and can be mounted by two persons
- ✓ Mounting, maintenance and repair requires no special equipment
- ✓ Can be mounted on both plan and curved surfaces
- ✓ Approved according to the highest fire requirements



Lightweight passive fire protection with **SkamoTunnel**

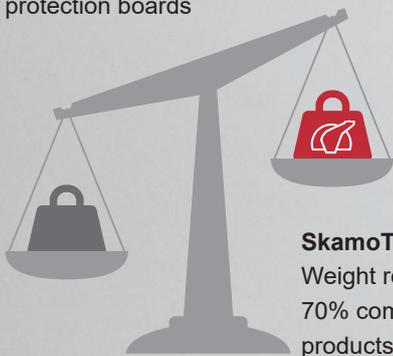
SkamoTunnel Board 250 weighs 10kg/m², meaning that individuals can manually carry a board without compromising on the work environment.

Furthermore, the easy handling of the boards contributes to the easy mounting of SkamoTunnel.

General about passive fire protection for tunnels

The passive fire protection boards used for tunnels are usually cement-bound, which results in a weight of up to 35kg/m² – and the need of special lift equipment during mounting.

Cement-bound passive fire protection boards



SkamoTunnel Board 250
Weight reduction of around 70% compared to other products in the market.

What is calcium silicate?

Calcium silicate boards are made of inorganic minerals in a highly porous structure.

The main constituents of calcium silicate are quicklime and microsilica, which is originally a by-product of silicon production.



Quicklime



Microsilica

International producer of calcium silicate

SkamoTunnel Board 250 is made of the lightweight material calcium silicate, which is produced in two of Skamol's factories.

Skamol has more than 35 years of experience with production of calcium silicate, and today exports to large parts of the world.

ection



All in one passive fire protection with **SkamoTunnel**



SkamoTunnel Board 250
Is a calcium silicate board.



Skamol Primer
Primer can be applied by both spray and roller.



Skamol Structural Plaster
This plaster is developed especially for this type of boards. It is a cement-based mortar modified to be applied to highly porous materials. It needs only a few days of curing before it can be painted.



Skamol Silicate Paint
This paint provides a smooth and durable surface suitable for cleaning of both non-plastered and plastered surfaces. It can be applied using both spray and roller. No primer needed.

tion system



Easy machining with **SkamoTunnel**

The SkamoTunnel Board 250 is made of calcium silicate, which is easy to:

- drill
- cut
- saw
- sand

No special equipment is required to fit boards to the desired dimensions, as ordinary wood-cutting tools can be used.

If required, the SkamoTunnel Board 250 can be supplied pre-cut according to the design of the specific project.

For more information about design, see page 20 to 24.



Optimize resources with **SkamoTunnel**

During the design of a tunnel project, Skamol offers its support in several design phases, to the benefit of both the environmental and financial perspectives of the project.

To name a few:

✓ **Optimization of materials**

To ensure the minimum waste of materials due to cut-off, we calculate the optimal mix of board dimensions for each project.

✓ **Optimization of fastener placement**

To simplify the mounting process and reducing the mounting time, we design a layout of fasteners for each project.





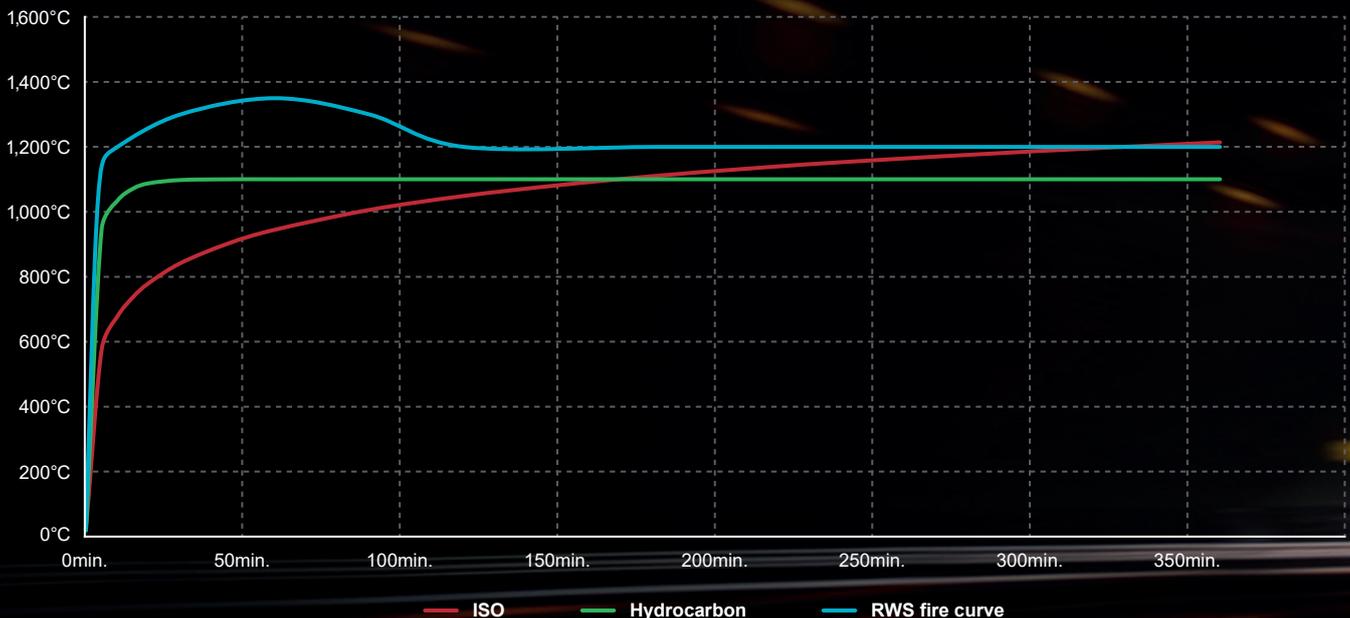
Classification reports for **SkamoTunnel**

SkamoTunnel has been tested and approved by the accredited Instytut Techniki Budowlanej according to Efectis-R0695:2020. This is the most severe fire curve, RWS curve for 180 minutes, and it concluded that SkamoTunnel protects concrete against spalling.

The RWS fire curve was developed by the Ministry of Transport in the Netherlands, the Rijkswaterstaat.

This fire curve is based on the assumption that in a worst-case scenario a 50m³ fuel, oil or petrol tanker will catch fire and a fire load of 300MW will occur.

As stated on the figure below the RWS fire curve is more severe than the ISO and Hydrocarbon fire curves and therefore also applicable for these.



Safe passive fire protection with **SkamoTunnel**

SkamoTunnel offers a second-to-none passive fire protection, as it is approved for the most severe fire curves, the RWS curve 180 minutes, and protects concrete against spalling.

SkamoTunnel contains no hazardous substances, e.g. it does not contain crystalline silica and crystalline fibre.

Moreover, it does not emit any dangerous substances during fire, which is documented in the test report "Emissions from Calcium Silicate boards during fire".





Freeze and thaw with SkamoTunnel

SkamoTunnel Board 250 has been tested according to EAD 350142-00-1106 "Fire protection board, slab, mat products and kits" to determine the weather-exposure classification. This is done through test made at the Danish Technological Institute where freeze/thaw results revealed a Type Y classification.

This classification states that the board can be used for internal and semi-exposure conditions.

SKEMA **DANAK** **DANISH TECHNOLOGICAL INSTITUTE**

Skamol A/S
Hanselgervej 1
DK-8260 Viby J

Order no. 969870
Page 1 of 1
Agreement Ref. PD3M1LD

Investigation No. 19
1st test Area: C
Tel. +45 72 22 10 00
Fax +45 72 22 10 10
info@dti.dk
www.dti.dk

Test report

Test specimen Sheets of fire protective insulator material according to EAD 350142-00-1106 with a bulk density of 250 kg/m³ (client information).
The client informs that the product is marketed as:
- SkamoTunnel Board 250

Sampling A sufficient number of test specimens were forwarded by the manufacturer and received at the Danish Technological Institute on 2021-03-05. The test specimens were numbered 969870 by the laboratory.

Method EN 12467:2012 Fibre-cement flat sheets - Product specifications and test methods, Clause 7.3.2. Bonding strength (after 25 cycles of freeze/thaw)

Period The testing was carried out from 2021-03-05 to 2021-04-15.

Result Classification of the test specimen according to EN 12467:
R_L = 0,916
Type Y products shall have R_L above 0,75 to be used as semi exposed.
The results of the test appear from appendix 1.

Notes The test has been performed according to the technical conditions, which are essential to the production but does by DANAK (The Danish Accreditation Scheme). The testing is only valid for the tested specimen. The test report may only be reviewed if the laboratory has approved the access.

2021-04-23, Danish Technological Institute, Building & Construction

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969870 - Skamol - 1808 after Freeze Thaw

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1902-2008
region to register
(ILAC) based
since successful
and calibration

to accreditation,
NAK, accredit-

the Council, the
agreement of the
of a compliance
body in ac-

Specimen No.	Result
1	0,916
2	0,916
3	0,916
4	0,916
5	0,916
6	0,916
7	0,916
8	0,916
9	0,916
10	0,916
11	0,916
12	0,916
13	0,916
14	0,916
15	0,916
16	0,916
17	0,916
18	0,916
19	0,916
20	0,916

DANISH TECHNOLOGICAL INSTITUTE

969870 - Skamol - 1808 after Freeze Thaw

DANISH TECHNOLOGICAL INSTITUTE

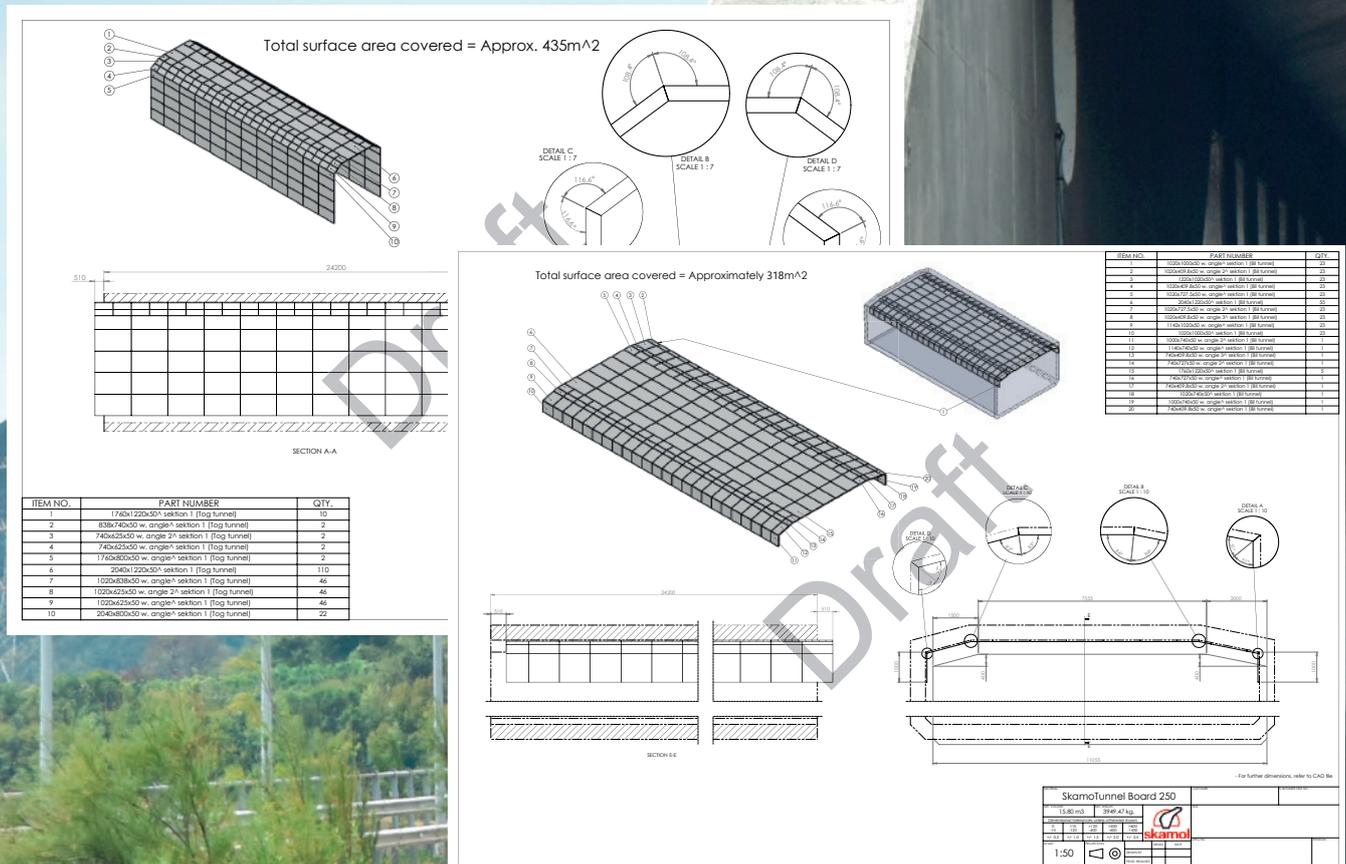
969870 - Skamol - 1808 after Freeze Thaw



Design of flat concrete tunnel with SkamoTunnel

Skamol is able to help during the design phase of a flat concrete tunnel to secure the most optimal and low waste solution by helping the designers to choose the most optimal boards dimensions.

Skamol is also able to calculate the correct fastener layout based on the forces acting in the flat concrete tunnel, which will ensure stability in the boards throughout their lifetime.



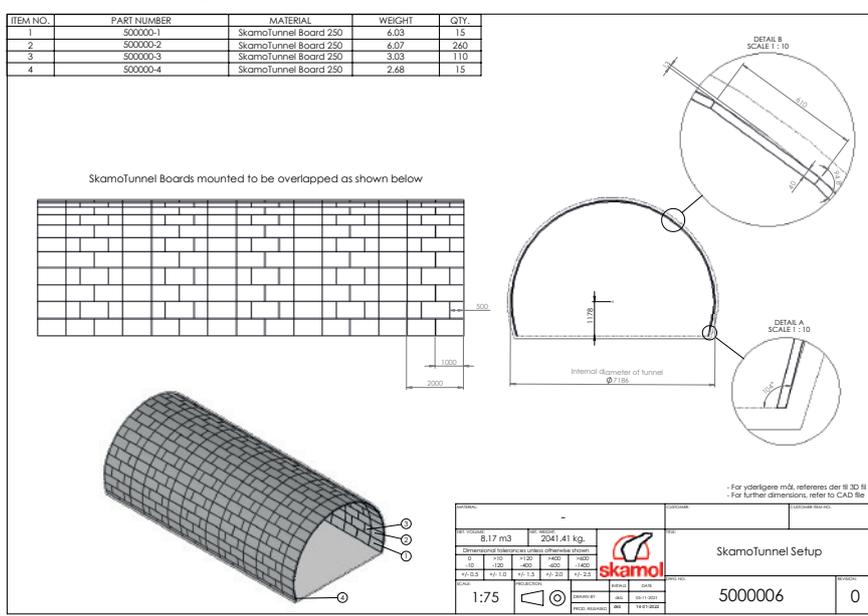
el



Design of curved concrete tunnel with **SkamoTunnel**

Skamol is able to help during the design phase of a curved concrete tunnel to secure the most optimal and low waste solution by helping the designers to choose the most optimal boards dimensions.

Skamol is also able to calculate the correct fastener layout based on the forces acting in the curved concrete tunnel, which will ensure stability in the boards throughout their lifetime.



nnel



Washability of **Skamol** Tunnel



According to the Norwegian National Road Directorate, washing of passive fire protection in tunnels is often done using high pressure water. Our test were conducted according to these requirements. Therefore, test with high pressure water has been conducted which created two options for washing.

First option is where the passive fire protection will need cleaning up to 2 times a year for 50 years. Here the solution would be to apply two layers of Skamol Silicate Paint. This paint can be applied by either spray or roller directly on to the board. No primer is needed.

Second option is where the passive fire protection will need cleaning for up to 10 times a year for 50 years. Here the solution would be to apply Skamol Primer, Skamol Structural Plaster and two layers of Skamol Silicate Paint.



Mounting instruction for **SkamoTunnel**

The SkamoTunnel Board 250 is available in dimensions up to 2,040×1,220mm in the thickness from 40mm.

The SkamoTunnel Board 250 can be mounted with both sides facing the tunnel.

The boards must be carefully placed into position and supported while the holes for fasteners are being drilled and the fasteners are being inserted.

The SkamoTunnel Board 250 can be cut with ordinary wood-cutting tools.

Fixing

Remove all unevenness bigger than 2mm from the concrete before mounting SkamoTunnel Board 250.

The fasteners must be inserted at least 120mm from the edge of the boards to avoid cracks and corners to break.

Wedge fastener HFB-R (Hilti) or another fastener which fulfills the following parameters:

- Material: Steel A4
- Diameter: 6mm
- Load capacity: Minimum 0.5kN
- Washer diameter: Minimum 30mm
- Fastener penetration in concrete: 35mm
- Base material: Concrete (both cracked and uncracked)
- Possibility of disassembly

Overview of mounting

On the following pages, a detailed description of the mounting can be found.



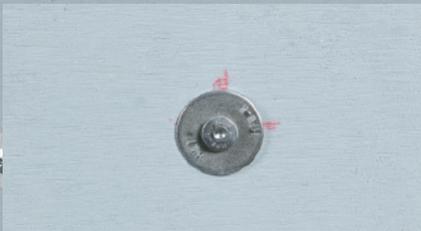
1 Position board.



2 Drill holes.



3 Insert fasteners.



4 Inspect fasteners.



5 Position board and repeat the process.



6 Position board and repeat the process.

Mounting step 1: Position board

The SkamoTunnel Board 250 must be held in a flat position against the concrete.

The position and number of fasteners must be designed beforehand and depend on requirement for each project as well as the board dimensions.

The red crosses mark the placement of fasteners on the board.



Mounting step 2: Drill holes

A rotary percussive drill is used to drill the holes for fasteners at the position marked with red.

Do not activate the percussion until the drill gets in contact with the concrete.

Drill into the concrete until the required fastener depth is reached.



Mounting step 3: Insert fasteners

Remove dust from the hole, e.g. with a blow-out pump, before the fasteners are inserted.

Insert the fasteners into the drilled holes and knock them into position until the washers are in contact with the surface of the SkamoTunnel Board 250.

Limit the force of the knock to avoid overdrive of the fasteners and damage to the SkamoTunnel Board 250.



Mounting step 4: Inspect fasteners

A visual inspection must be done to ensure that the fasteners are secured and in contact with the surface of the SkamoTunnel Board 250.

Fasteners which do not fulfill these requirements must be replaced.



Mounting step 5: Position board

Place the SkamoTunnel Board 250 next to the mounted board and repeat the process.

Ensure that the butt joints between the boards are as close as possible.

The gap between the boards must not exceed 1mm.



Mounting step 6: Position board

Place the SkamoTunnel Board 250 in bond just above the butt joint.

Place the boards as close as possible and repeat the process with the fasteners.

The gab between the boards must not exceed 1mm.



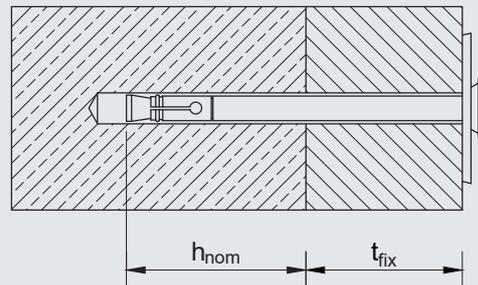
Fasteners for SkamoTunnel



Example of fastener.

Wedge fastener HFB-R (Hilti) or another fastener which fulfills the following parameters:

- Material: Steel A4
- Diameter: 6mm
- Load capacity: Minimum 0.5kN
- Washer diameter: Minimum 30mm
- Base material: Concrete (both cracked and uncracked)
- Possibility of disassembly
- Fastener depth in concrete: 35mm

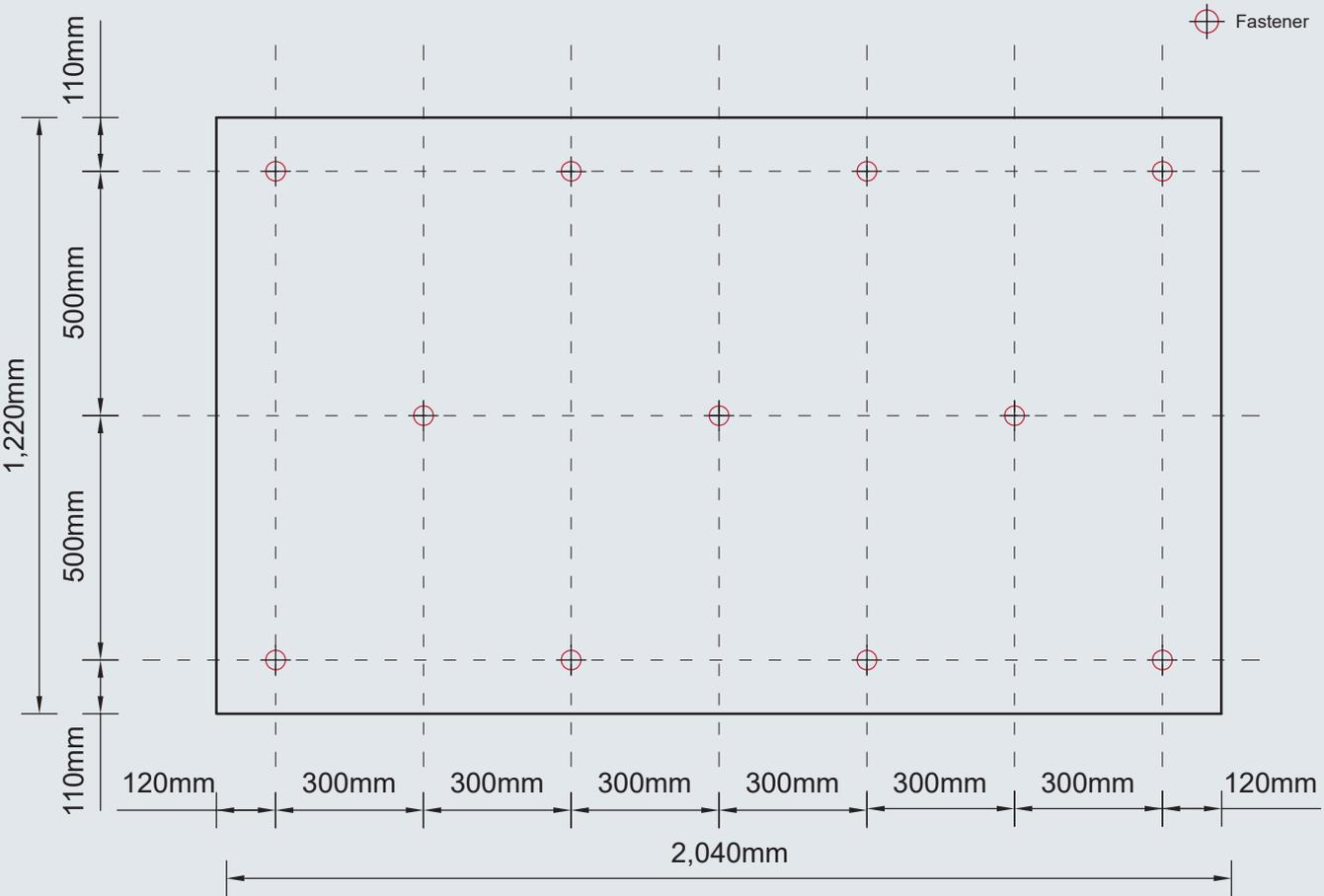


How to attach the fastener

The SkamoTunnel Board 250 should be attached to the concrete substrate with the use of fasteners described above. The drawing below defines the dimensions between the grid's axes of the fasteners for a full-size board. When using a board with smaller dimensions, the arrangement of the fasteners should be adjusted so as not to exceed the maximum distances between the fasteners specified in the drawing below. The fasteners lying on the central axis (running parallel to the longer edge of the plate) are shifted by half the distance between the fasteners.

The width of the joint between the edges of the boards must not exceed 1mm.

For the test the number of fasteners was 4.5 per m² but this number will be adjusted to the specific requirement for each project.



Maintenance during lifetime of **Skamo**Tunnel



Boards can be taken down and fasteners be removed in order to inspect the concrete behind and repair any leakage or damage to the concrete.

After a fire the boards can easily be removed and replaced according to the major repair instruction for SkamoTunnel, see page 40.

Protection of expansion joints with **SkamoTunnel**

Example of how to protect expansion joints.

Concrete wall

Section joint

GROSS VOLUME: m3 GROSS WEIGHT: kg.

MATERIAL: SkamoTunnel Board 250

NET VOLUME: m3 NET WEIGHT: kg

Dimensional tolerances unless otherwise shown:

0	>10	>100	>400	>600
-10	-100	-400	-600	-1400
+/- 0.5	+/- 1.0	+/- 1.5	+/- 2.0	+/- 2.5

skamol

Expansion joint

SCALE: 1:20

PROJECTION:

DESIGNED BY: UHJ DATE: 22-04-2021

DRAWN BY: UHJ

PROD. RELEASED:

FIG. NO.:

REVISION:

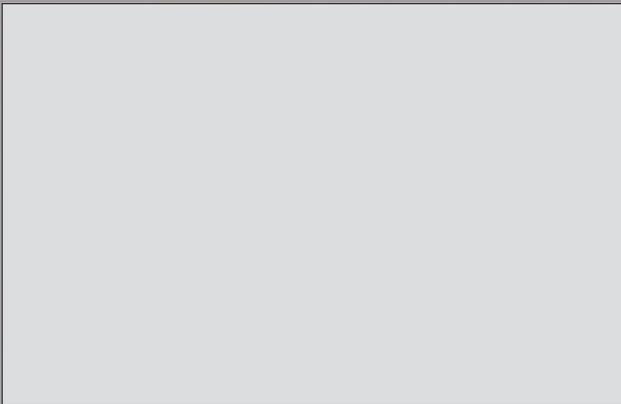
- For yderligere mål, refereres der til 3D fil
- For further dimensions, refer to CAD file

Plaster, paints, colours for **Skamo**Tunnel

Depending on the demand for resistance to washing and aesthetics, the tunnel the SkamoTunnel Board 250 can be painted with Skamol Silicate Paint without a need of a primer.

If a higher demand of resistance to washing is needed, and a different texture of the surface is needed our Skamol Structural Plaster can be used beneath the paint.

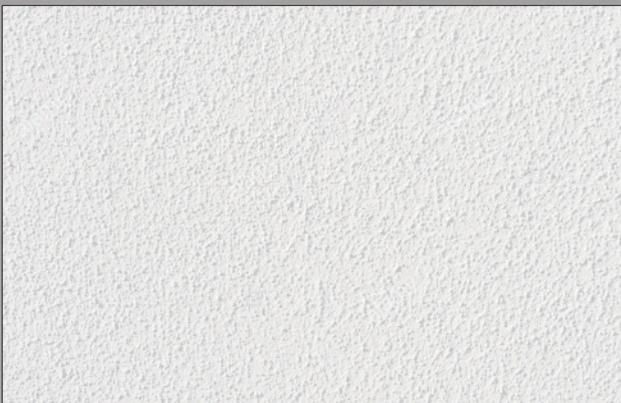
The paint can be applied both by brush or spray, making it easier to apply the paint.



SkamoTunnel Board 250

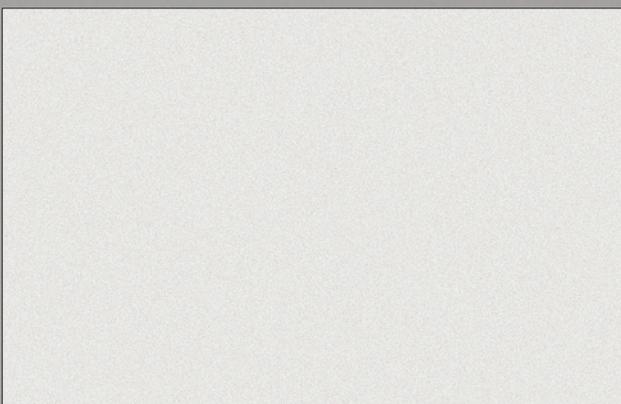
Is a gray calcium silicate board with a slightly dusty surface.

We recommend to apply either Skamol Structural Plaster or Skamol Silicate Paint on SkamoTunnel Board 250 to get a more resistant surface.



Skamol Structural Plaster

Skamol Structural Plaster is a white coarse-grained plaster with a grain size of 1-2mm that can be painted with a Skamol Silicate Paint.

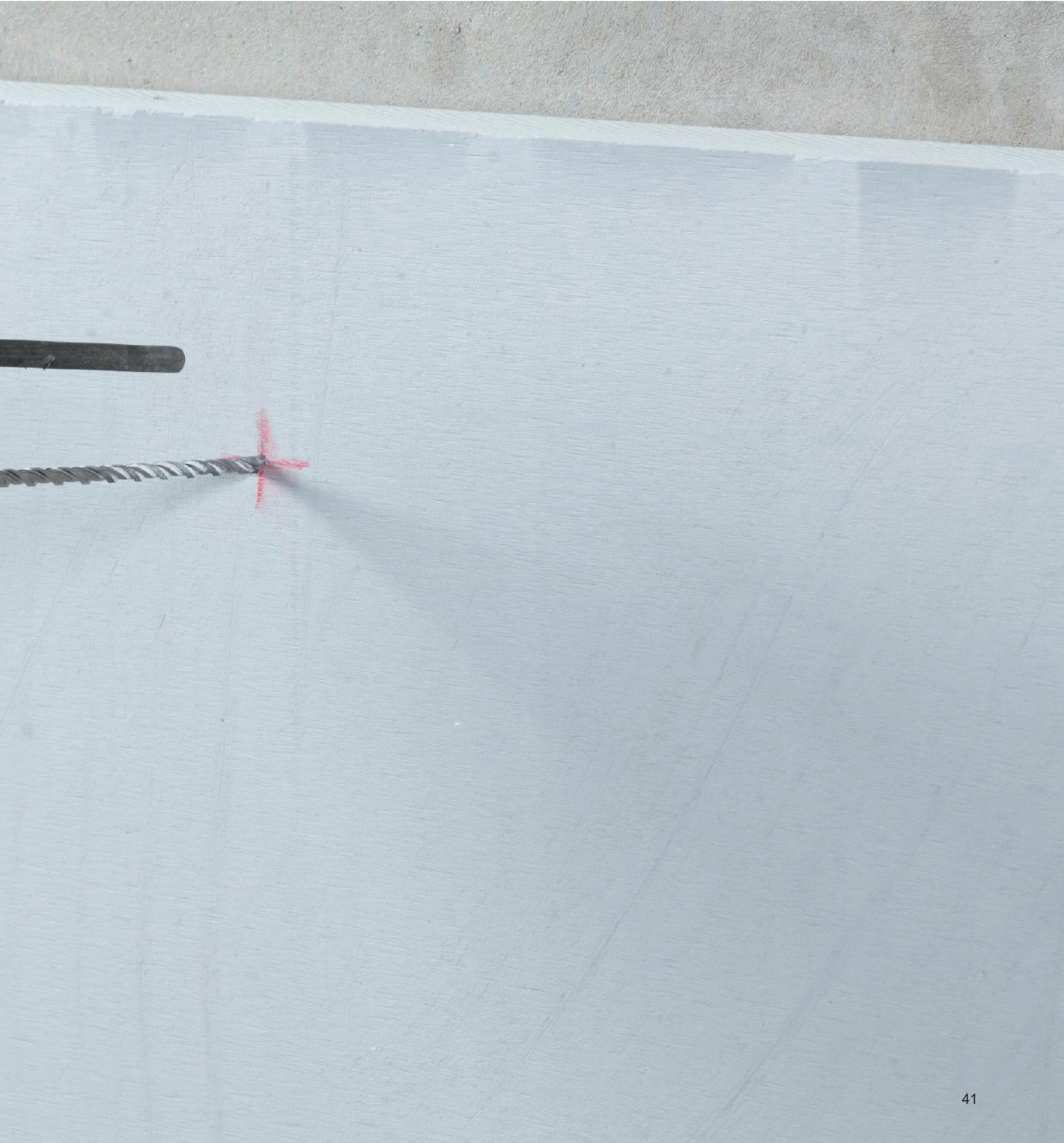


Skamol Silicate Paint

Skamol Silicate Paint is supplied in multiple colours, and can be applied directly on SkamoTunnel Board 250.

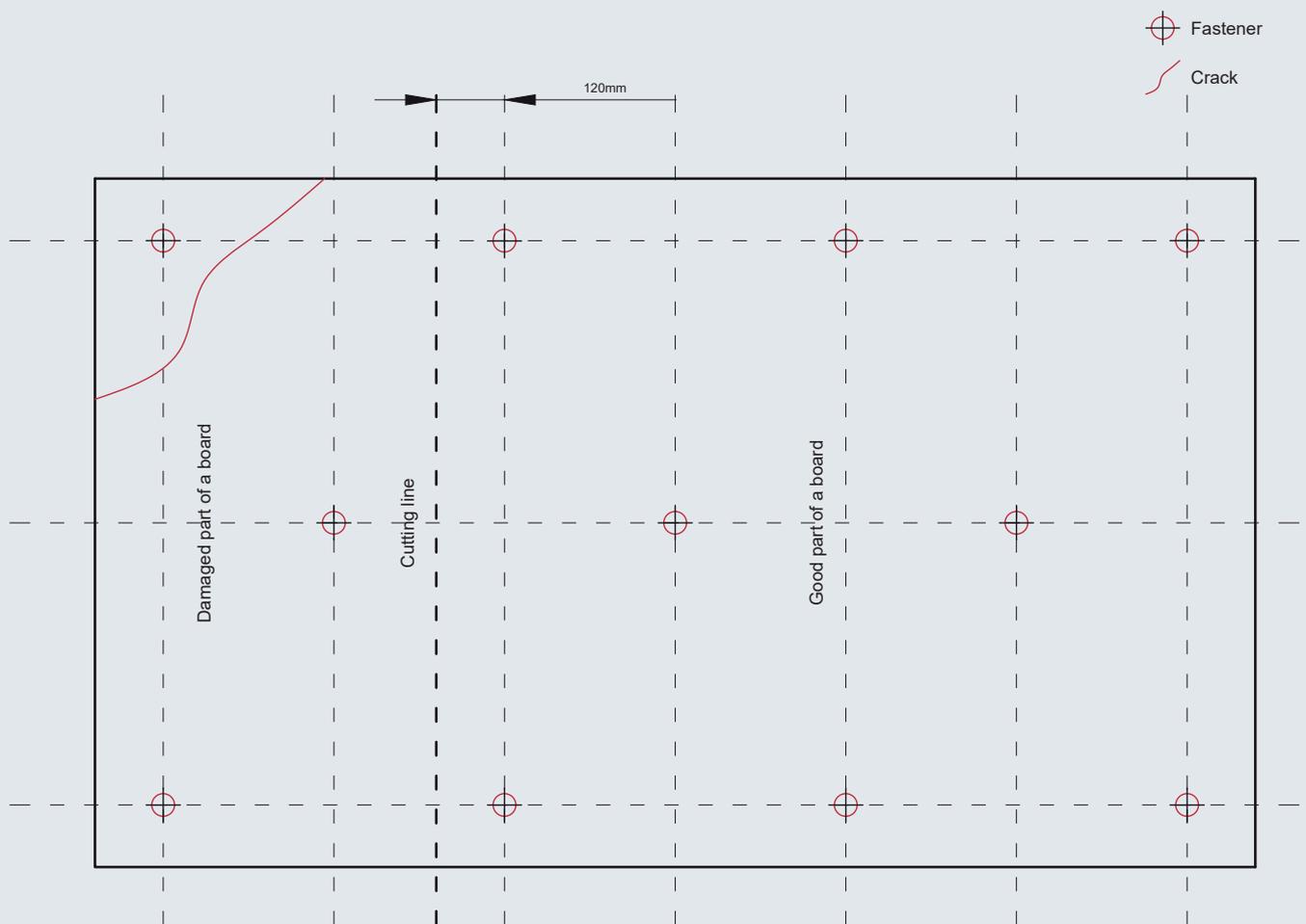
Major repair instruction for **Skamo**Tunnel





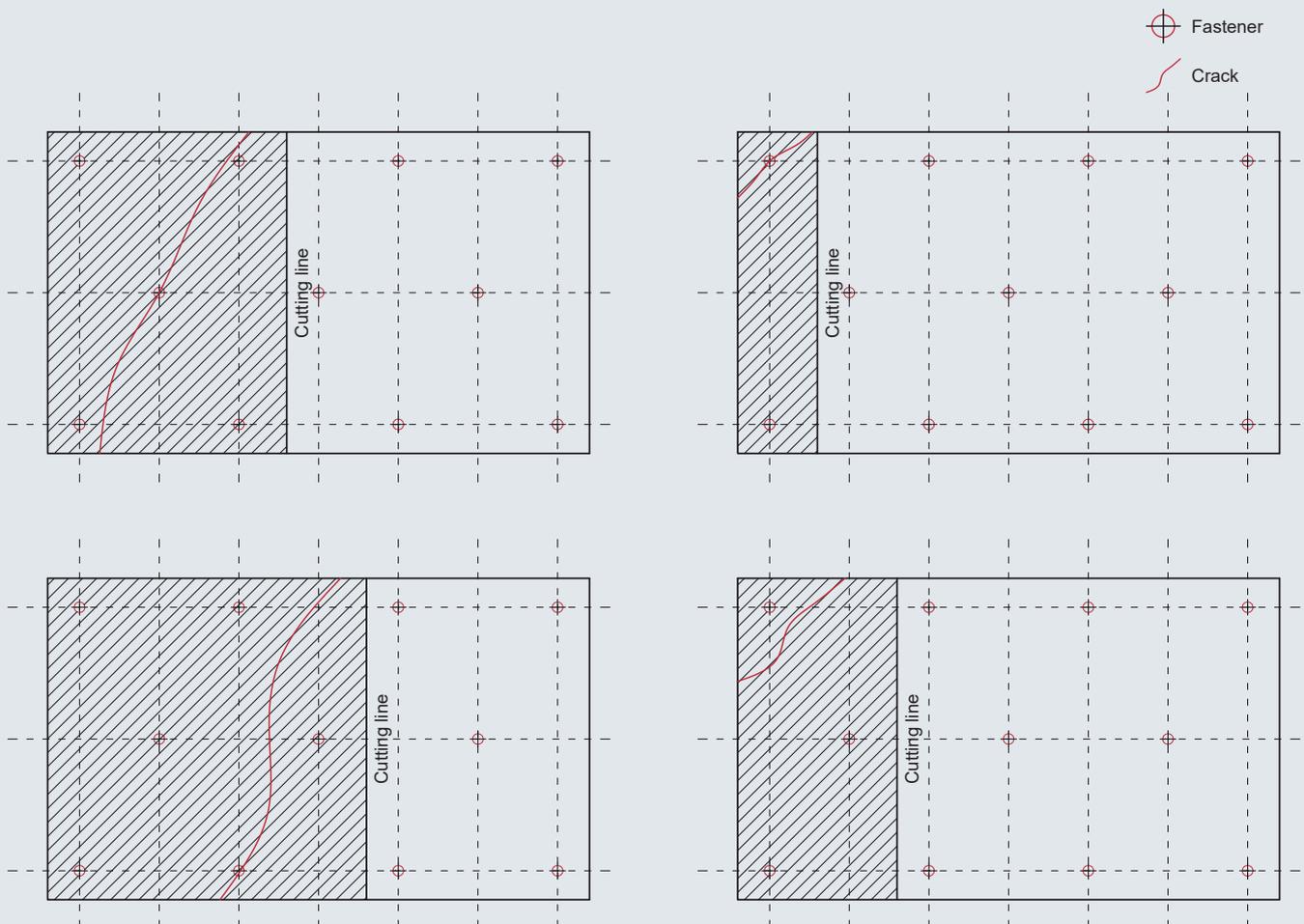
Principle of major repairment

The principle of major repairment in case of a crack or other damage in SkamoTunnel Board 250 is to cut off a piece of the board perpendicular to the long edge and replace it with a new piece of board. The cutting edge should be distanced 120mm from the fasteners' line in the remaining part of the board.



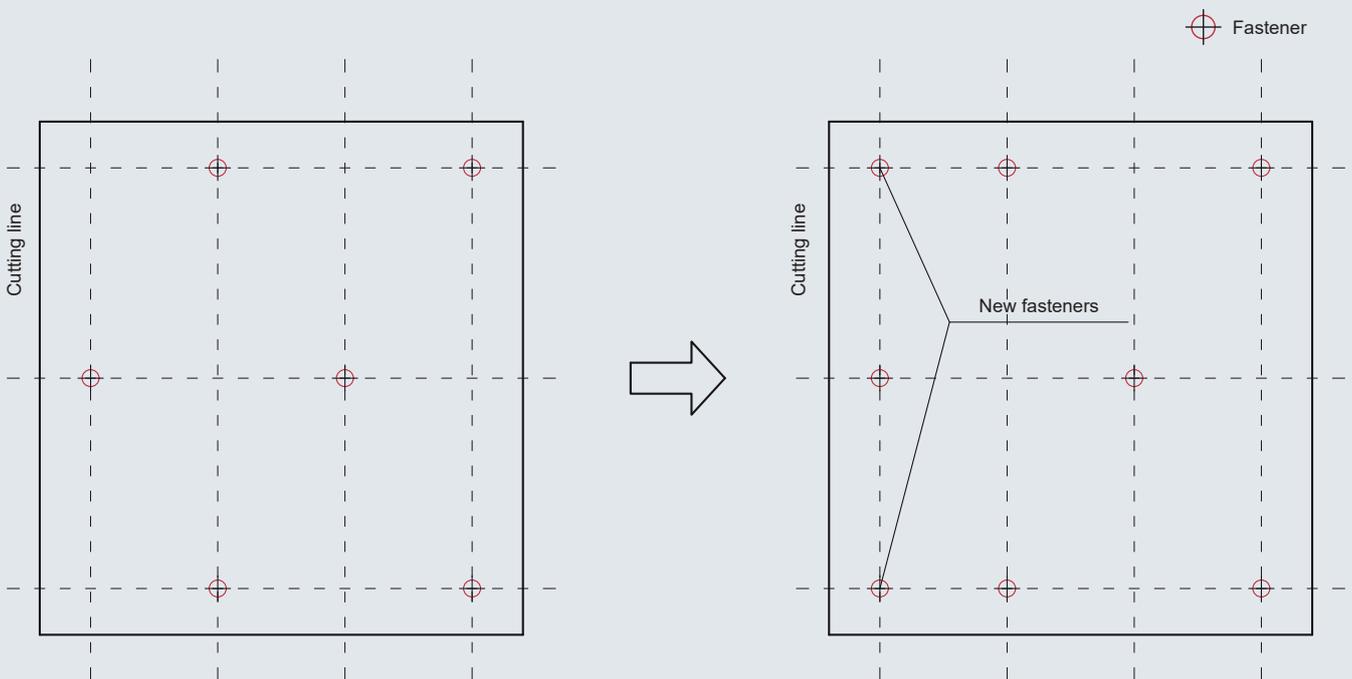
Examples of major damages

The illustration below contains examples of major damages (red line) and the area of the board to remove (hatched area).



New fasteners

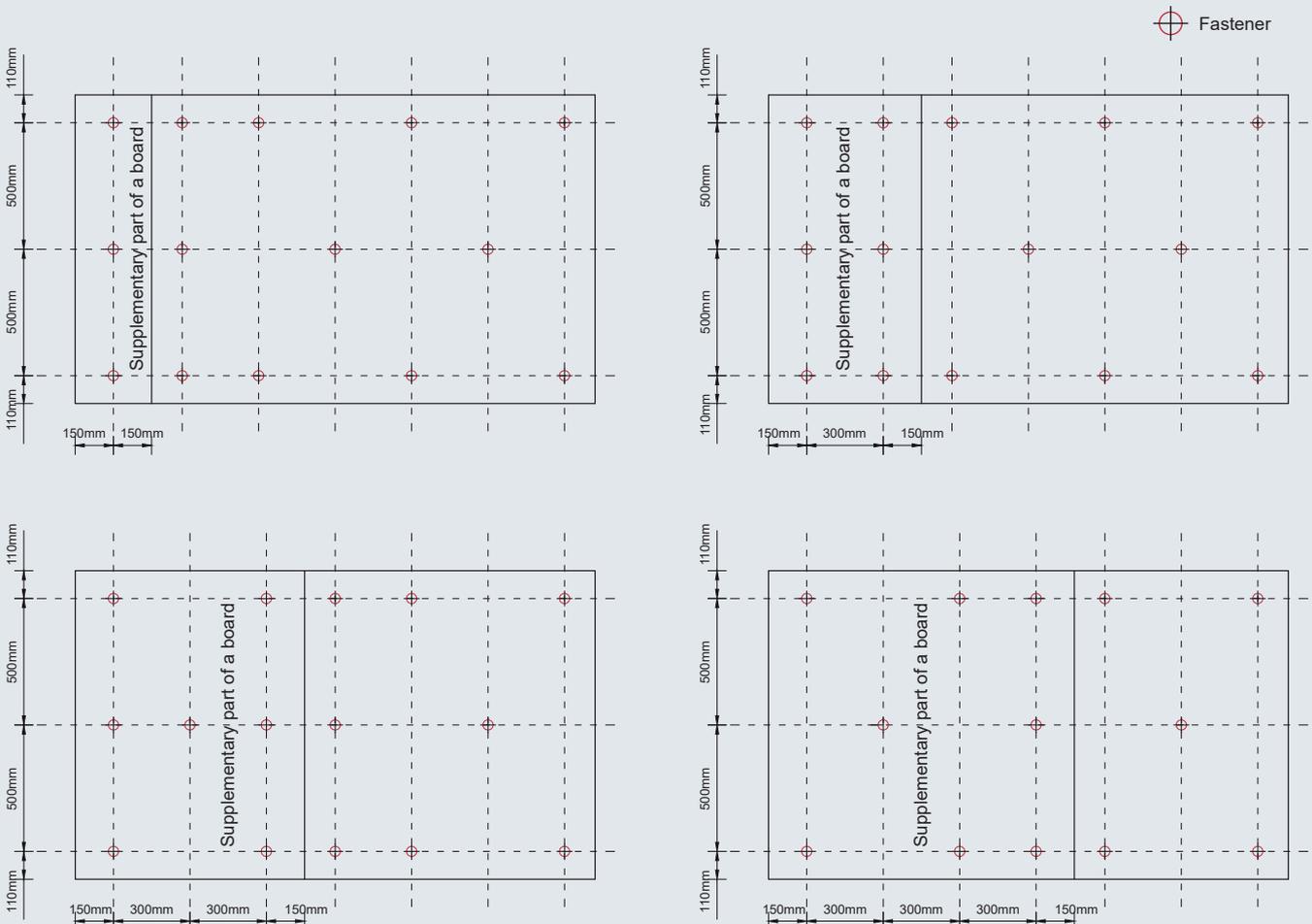
If a new edge line contains only one fastener, the line of fastener shall be complemented.



Supplementary piece of the board

A supplementary piece of the board shall contain fasteners arrangement dependent on the size of board as illustrated below.

The below description of the system's major repairment is adequate for the fasteners' layout presented at the beginning of this document. The way of major system repairment with different fasteners layout may differ and should be approved by Skamol for specific projects.



Repair of minor damage on SkamoTunnel

The principle of repairment in case of minor damage in SkamoTunnel Board 250 is to fill out the damages with a fire approved sealant.

Through trials the actual sealant must be proved to stick to the SkamoTunnel Board 250 after hardening.

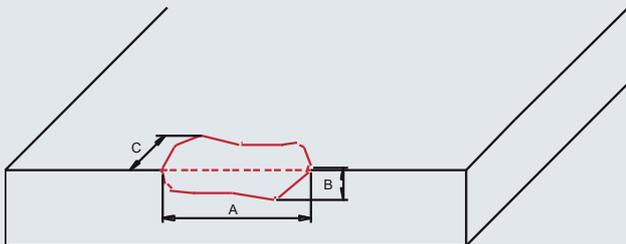
Skamol can assist in this part of approving specific sealants for use together with SkamoTunnel Board 250.

For repair of damages bigger than the below described, please see major repair instruction for SkamoTunnel, page 40.

The illustrations below show examples of chip offs that need to be repaired.

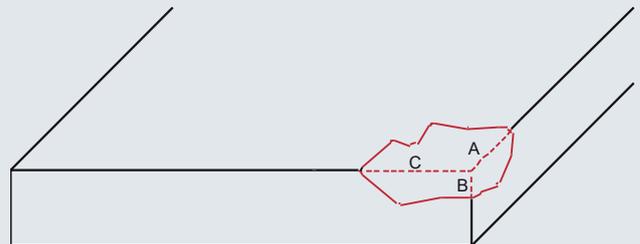
Maximum defects possible to be repaired using sealant

Repair of edge



Board thickness	>50mm	<50mm
Defect A	<75 mm	<50mm
Defect B	<20mm	<15mm
Defect C	<20mm	<15mm

Repair of corner

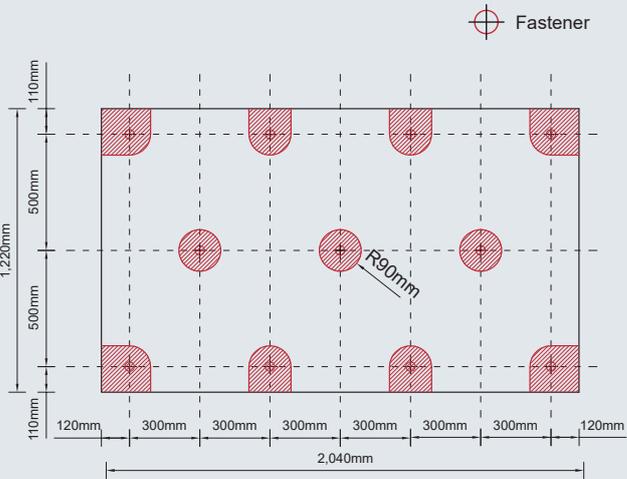
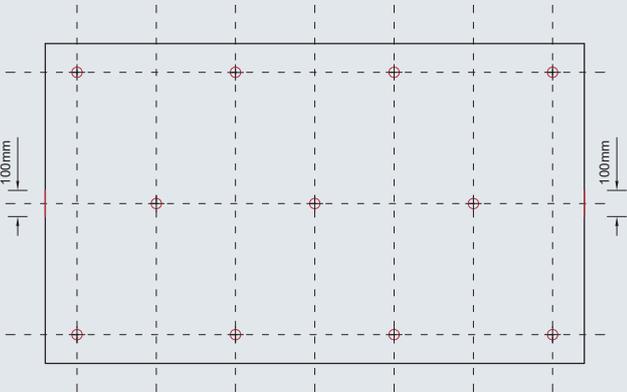


Board thickness	>50mm	<50mm
Defect A	<30mm	<20mm
Defect B	<30mm	<20mm
Defect C	<30mm	<20mm

In areas marked with red only damages up to 10 mm must be repaired

Areas marked with red, where drilled holes should be avoided.

If holes are drilled anyway, the repair must be according to major repair instruction for SkamoTunnel, see page 40.



Repair after temporary and a with **SkamoTunnel**

If temporary installations are needed during construction of the tunnel, holes after bolts and screws must be repaired, when the installation is removed:

- **Holes <10mm in diameter**
no repair needed.
- **Holes ≥10mm to 50mm in diameter**
must be repaired with a fire approved sealant.
- **Holes ≥50mm in diameter**
must be repaired according to major repair instruction for SkamoTunnel, see page 40.

Sealants around permanent installations

Already during the design phase, the layout of fire boards and fasteners must be made, to secure proper fastening.

When tubes, fittings and other equipment penetrates the fire boards the width of the joints/sealant to the fire boards must not exceed 50mm.

If required, intumescent sealing must be used.

round permanent installation

Datasheet: Skamo Tunnel Board 250

	Value	Unit
Bulk density	250	kg/m ³
Board weight (40mm thickness)	10.0	kg/m ²
Compressive strength	3.1	MPa
Flexural tensile strength	1.5	MPa
Freeze-thaw resistant for weather exposure category	Y (semi-exposure)	
Non-combustibility tests	Class A1	
Surface washability according to the Norwegian National Road Directorate	Yes	
RWS	180	minutes
Emissions from calcium silicate board during fire (VOC and SVOC)	Below WHO recommendation	
HS Tariff number (Harmonized Commodity Description and Coding System)	6806.90.00	
Colour	Grey	

Size	Length	Width	Thickness
Maximum	2,440mm	1,220mm	105mm
Minimum	According to your specification	According to your specification	40mm
Standard tolerances	Up to ±1.5mm	Up to ±1.5mm	Up to +2.0mm

Machining

Special shapes machined to customer specification can be supplied for specific design requirements.

Packaging

Products will be packed according to the Skamol standard.



Data are average results of tests conducted under standard procedures and are subject to variation. Data contained in this data sheet are supplied in good faith as a technical service and are subject to change without notice. Misprint and errors excepted. Revision number: 14.7.2022

Datasheet: **Skamol Primer**

	Value	Unit
Contains a maximum of	1.4	g VOC/L
General		
Spreading capacity	5	m ² /L
Drying time	min. 30	minutes
Pouring temperature	min. +5	°C
Shelf life	12	months
Colour	Transparent	



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Datasheet: Skamol Structural Plaster

	Value	Unit
Bulk density	1,400 to 1,500	kg/m ³
Water vapour transmission, μ (EN 1015-19)	≤ 15	
General		
Bag size	20	kg
Consumption, 2mm (per bag)	7.5	m ²
Shelf life	12	months
Pouring temperature	+5 to +25	°C
Opening time at +20°C	60	minutes
Added water (per bag)	3.6 to 4.1	L
Classification reaction to fire (EN 13501-1:2007 + A1:2009)	Class A1	
HS Tariff number (Harmonized Commodity Description and Coding System)	2824.50.90	
Colour	White	



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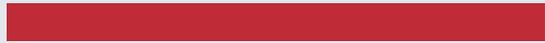
Datasheet: **Skamol** Silicate Paint

	Value	Unit
VOC	<5	%
Non-flammable		
High abrasion and scratch resistance		
Yield	4 to 5	m ² /L
Application conditions	+8 to +25	°C
Drying time	12	hours
Shelf life	12	months
Storage conditions	+5 to +35	°C
HS Tariff number (Harmonized Commodity Description and Coding System)		
Colour	White	



Data are average results of tests conducted under standard procedures and are subject to variation. Data contained in this data sheet are supplied in good faith as a technical service and are subject to change without notice. Misprint and errors excepted. Revision number: 14.7.2022

All in  **one**



Learn more at www.skamol.com