

NORTHERN LIGHTS

— *Porcelain* —

F A B R I C A T I O N
G U I D E L I N E S

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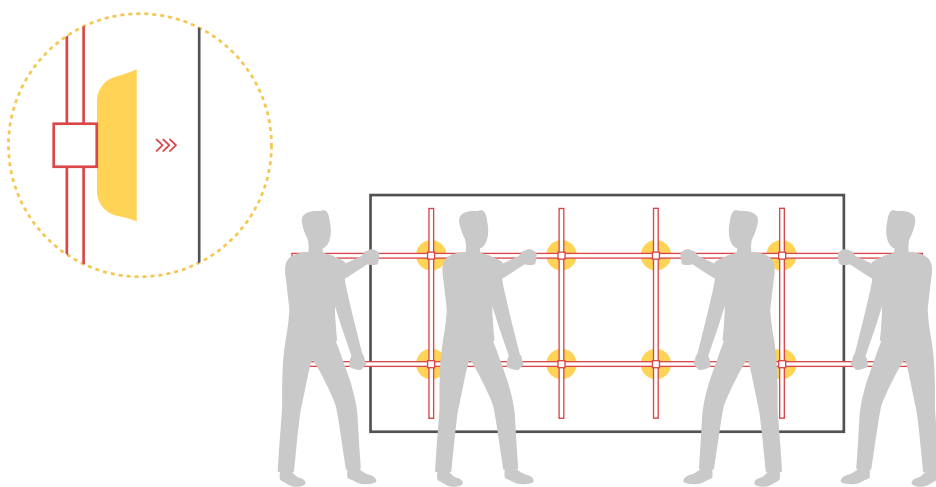
HANDLING, STORAGE & INSPECTION

HANDLING

Manual (Suction Cup)

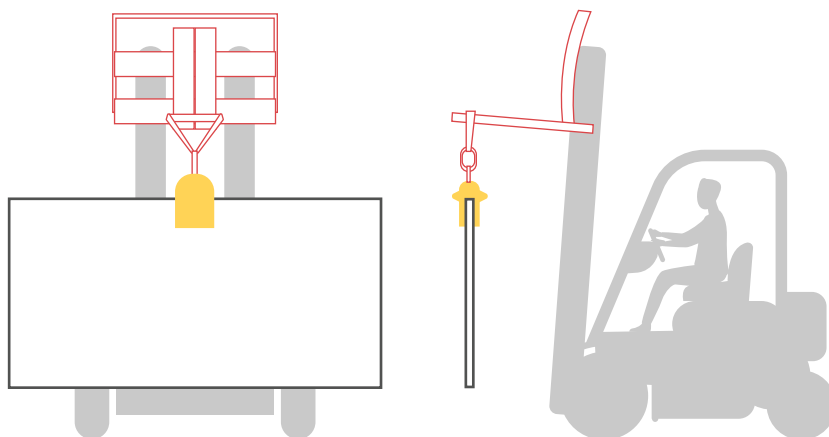
NL Porcelain weighs 150 kg and must be handled and carried with appropriate care and safety to avoid damage to the material. We recommend using a frame with suction cups.

Panels should be handled by 4 or more operators. Anti-slip and anti-cut gloves are required to ensure a firm grip and protect hands.



With Equipment (Crane and Forklift Truck)

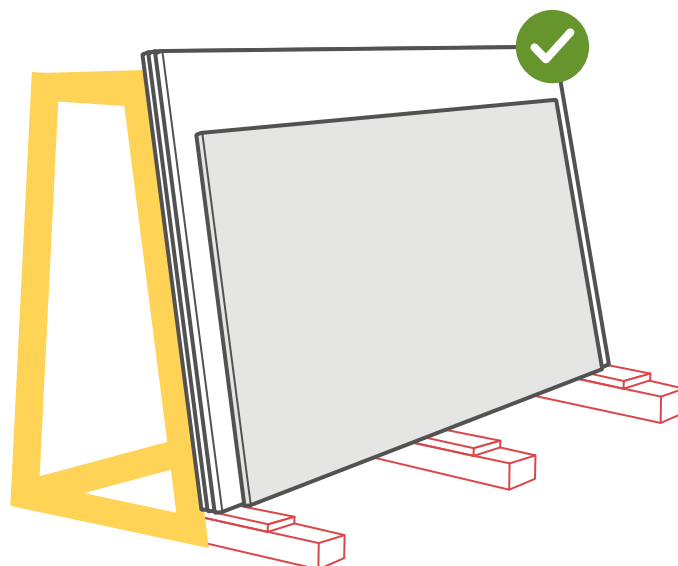
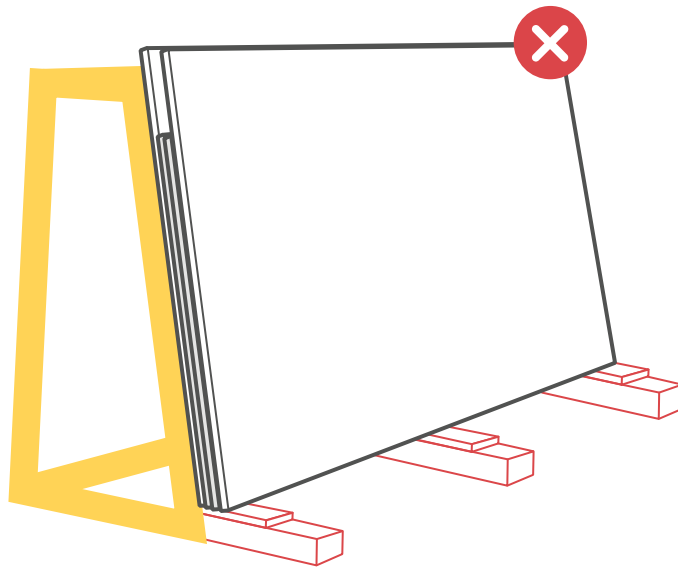
Use suitable slab clamps or stone lifters, with vulcanized rubber pads to avoid slippage or any possible damage. Remove the slabs from each side of the A-frame alternately in order to balance the weight and to prevent tipping. It is not recommended to lift more than two slabs with a clamp a time.



STORAGE

The slabs are packed on a metal A-frame. It must be handled individually with care and stacked on their side. Insert (soft) materials (e.g. wooden shim and rubber) under the slabs and the support to prevent any damages.

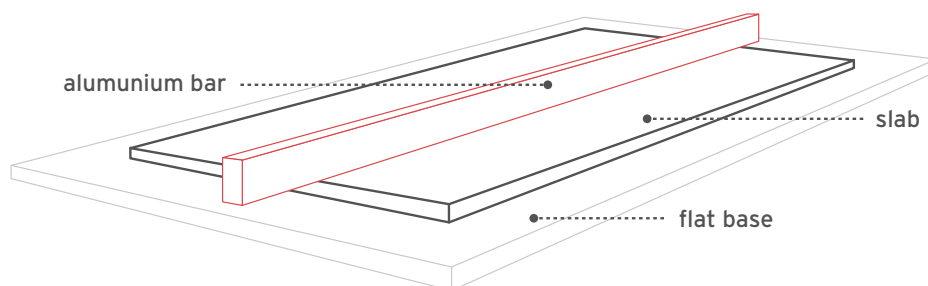
The slabs should always be properly supported to avoid bending and stored in areas that are not subject to accidental impacts (workplace transport or manoeuvring areas). The smaller slabs should never be placed between the large panels.



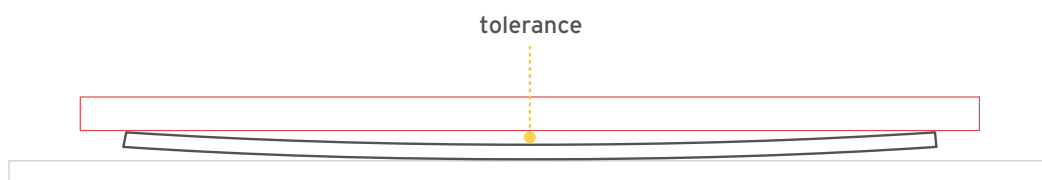
INSPECTION

Before carrying out any processing, it's recommended to clean the slab and check for any curvature. It's necessary to do an inspection of the slab to make sure that it meets all the quality requirements.

To check the flatness of a slab, it should be layed down horizontally on a completely clean and flat base. The flatness is measured by placing a material on the surface of the slab, covering the entire width and lenght of the slab. Avoid measuring the slab on A-frame.



* Flatness is measured using an aluminium bar and thickness measuring tools in the centre.



Maximum tolerance width: 2mm

Maximum tolerance length: 3 mm

PROCESSING TYPE

There are two kinds of processing our slabs:

1. Manual processing

Performed using handy tools, usually outside the workshop or at the job site.

2. Machine processing

Performed using fabrication machine, usually in the workshop.



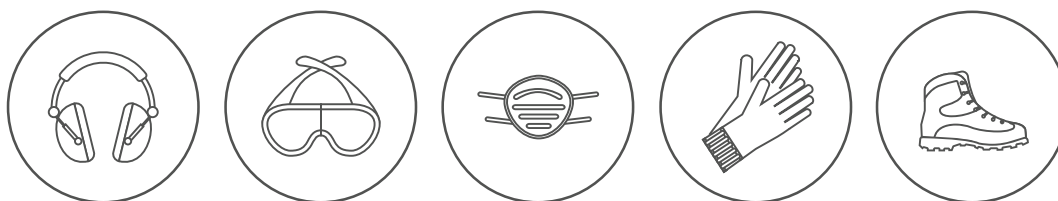


MANUAL PROCESSING

MANUAL PROCESSING

This guideline provides technical and practical information about manual fabrication techniques, and finishing recommendations. We recommend to carefully follow the instructions using the tools recommended by Northern Lights Porcelain.

Each worker has to wear specific PPE (Personal Protective Equipment) for the work to be performed.



* A preliminary tests for both cutting and drilling is good, in order to gain familiarity and avoid any problems.

4.1 Cutting

Tools recommendations for cutting on site.



Marble / Tile Cutter
1,200W RPM 13,000



Angle grinder
900W, RPM 2,800-11,000



Cutting blade 4"

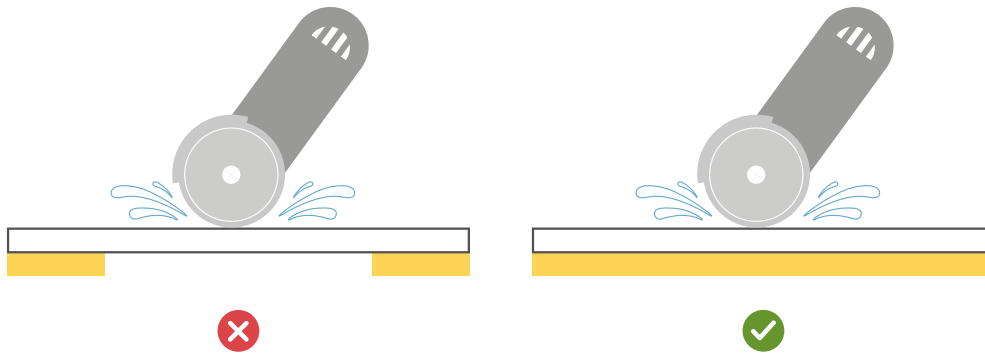
Process

The slab must be processed in a suitable position to avoid movements and vibrations. We strongly recommend using a foam board on the surface of the saw table. Any issues related to hard saw tables can be avoided by using a 1" foam board underneath. This will take the vibration out, and lead to better results.

The area being processed should be bathed with water constantly and frequently, and the tool also, in order to guarantee proper cooling and dust suppression. Northern Lights Porcelain does not recommend to perform dry cutting.

The slab must be processed in a suitable position to avoid movements and vibrations.

The slabs must be properly supported during any processing. The support should be sufficiently rigid, perfectly flat, and covering the entire bottom of slabs. A wooden support is preferable to a metal one to avoid scratches.



* Always work from the top (finished surface) towards the bottom (raw surface)
It is recommended that the upper and lower edge of the newly cut edge is lightly sanded using 60/120 grain diamond sandpaper.

4.2 Drilling

Tools recommendations for drilling on site.



Electrill drill



Diamond hole cutter



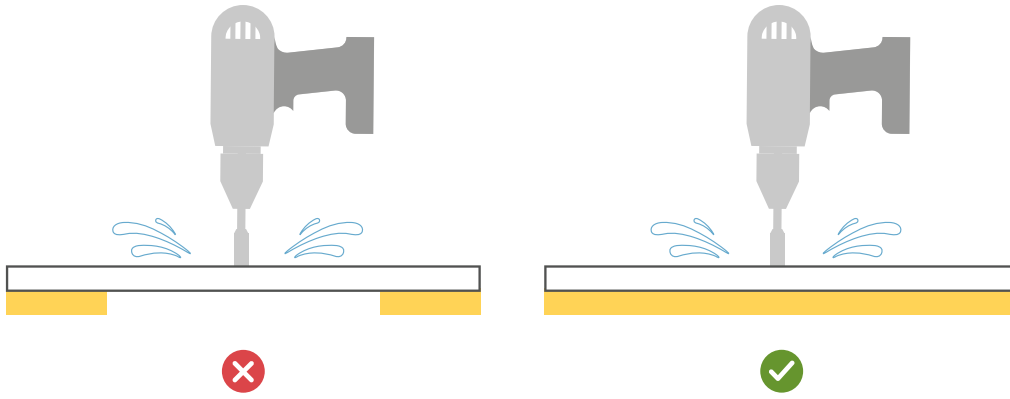
Pad polish

Process

If it is required to drill holes (for piping, air vents, etc.), the slabs must be properly supported, as in the case when cutting.

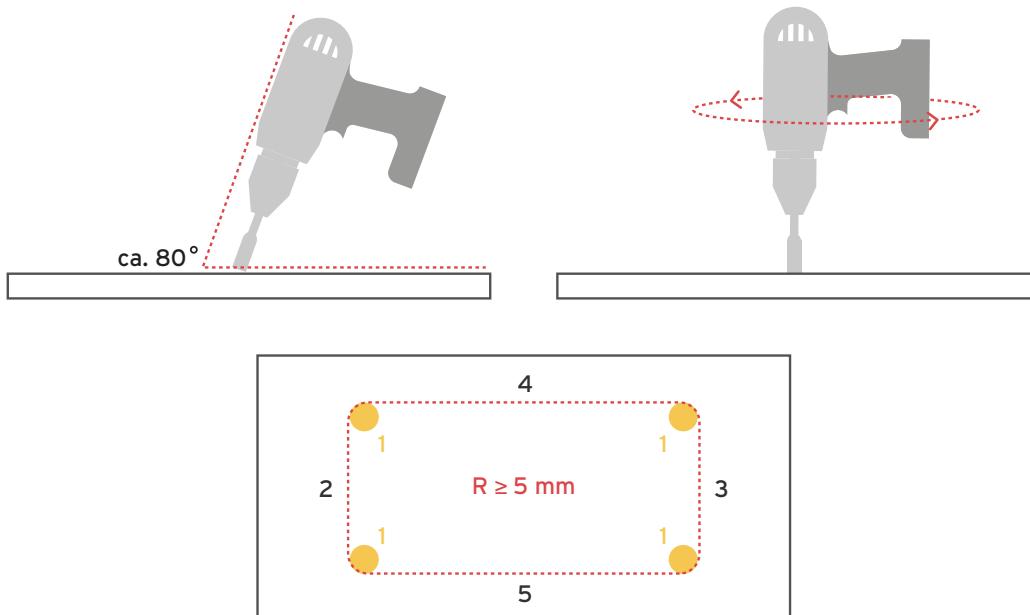
The area being processed should be bathed with water constantly or frequently, and the tool also, in order to guarantee proper cooling and dust suppression.

Northern Lights Porcelain does not recommend to perform dry drilling.



* Always work from the top (finished surface) towards the bottom (raw surface)
 Avoid any hammering to avoid breakage during drilling operations.

It is necessary to perform a pre-drill with a radius of $\geq 5\text{mm}$ at all 4 corners. Then continue to cut the sink. Each drilling point scores the surface about an 80-degree angle, drilling in a gentle circular motion.



1 Hole drilling

2-3-4 Sink cut out (start with the short part then the long part)

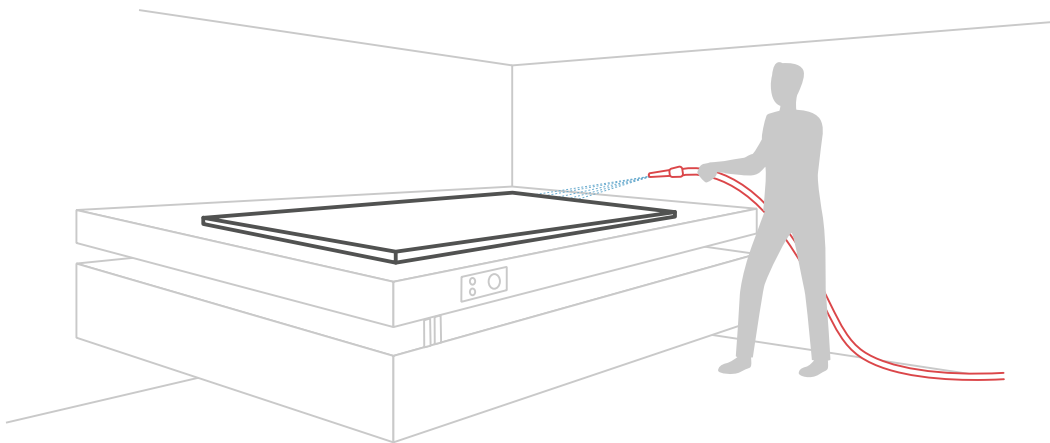


MACHINE PROCESSING

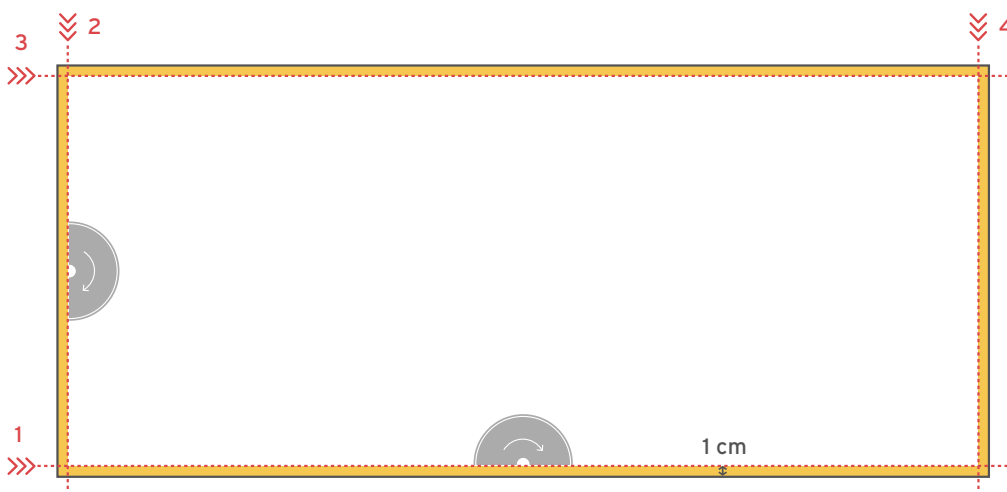
MACHINE PROCESSING

This guideline provides technical and practical information about machine fabrication techniques, and finishing recommendations. Please carefully follow the instructions using the tools recommended by Northern Lights Porcelain.

Before performing any processing, clean the slab properly and check for any curvature, and any non-compliances with normal quality standards.



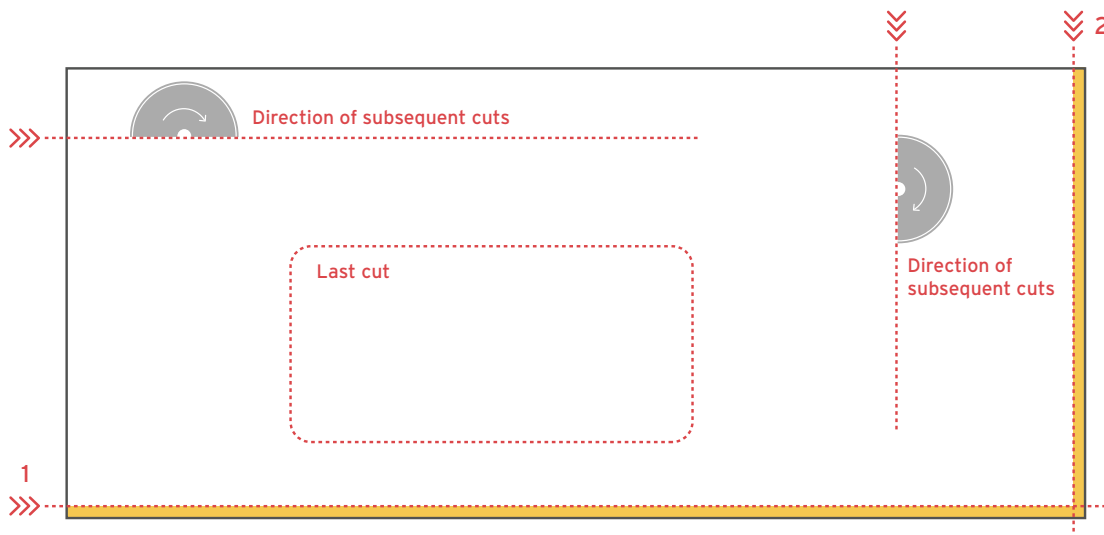
Then, the slab must be trimmed 4 sides at a minimum 1 cm away from the edge to release tension, so there will be no obstacle for the next processing step. Then continue to cut according to desired size.



* Follow the safety instructions.

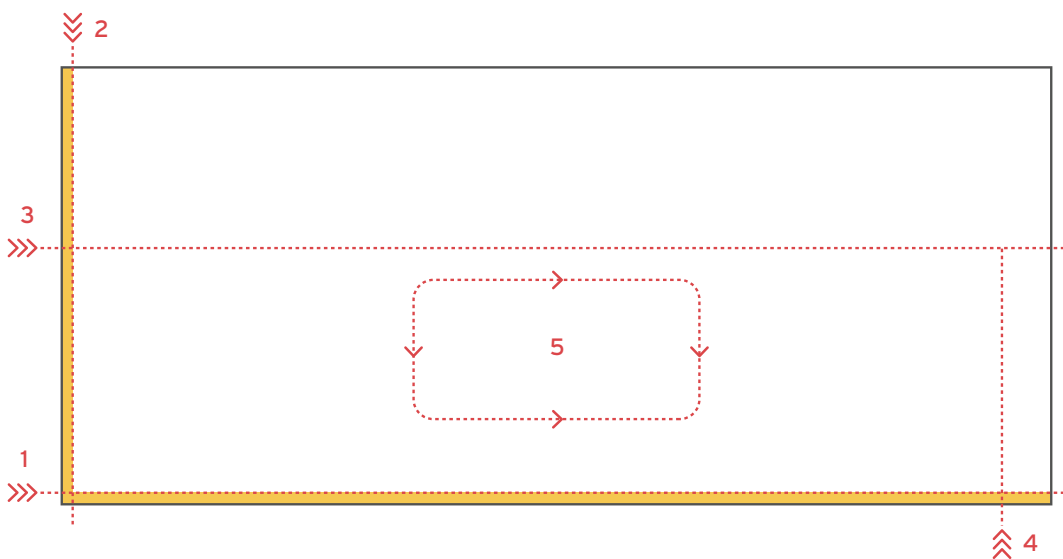
After each processing, it is advisable to rinse the surface thoroughly with clean water.

For each processing, the cutting direction must always be consistent with the rotation of the disc.



Processing with Bridge Saw

Below is cutting recommendation using bridge saw.



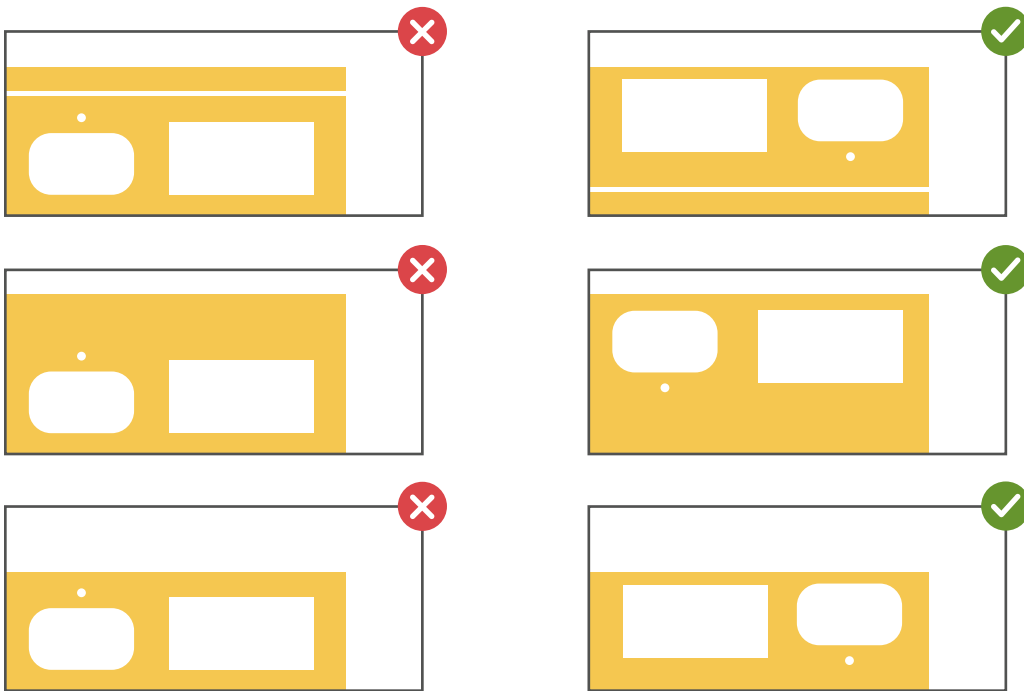
1-2 Slab trimming

3-4 Countertop perimeter cuts

5 Sink cut-out

Workpiece Positioning

It's recommended to put holes for sinks or cooktops towards the central part of the slab.

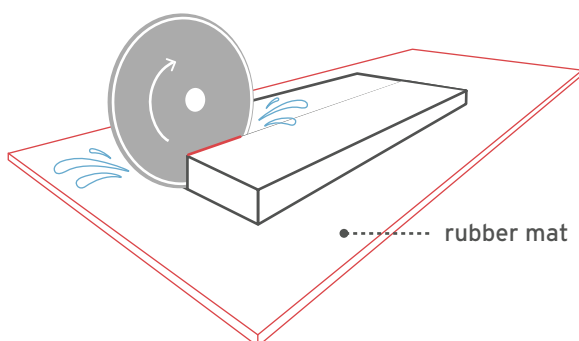


Cutting Blade

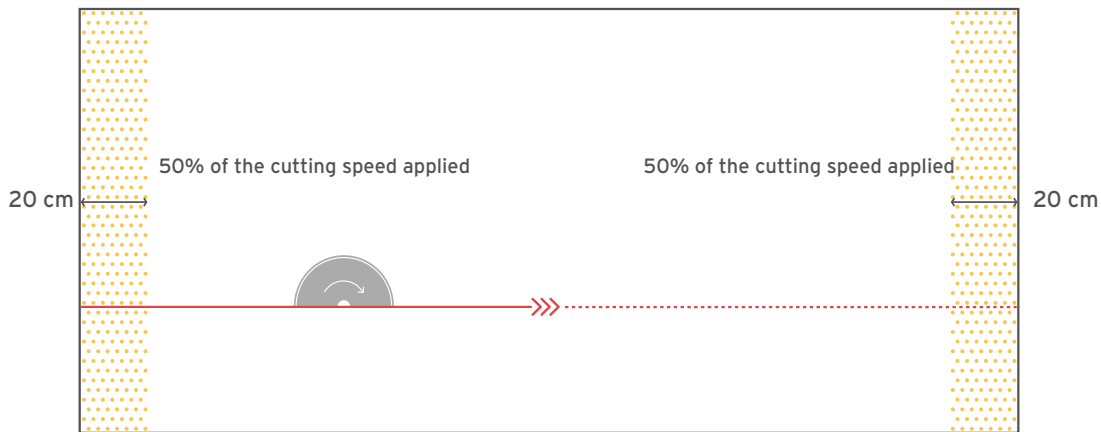
Always use plenty of water when processing. The water flow must be headed to the front and side of the disc, as close as possible to the cutting area.

Make sure that the cutting bench is in good condition and flat. It is recommended to use a high-density technical rubber mat between the slab and the cutting table to reduce vibrations and improve the cutting finish.

* Insufficient water flow will cause the disc to overheat, it can lower the success of the operation.

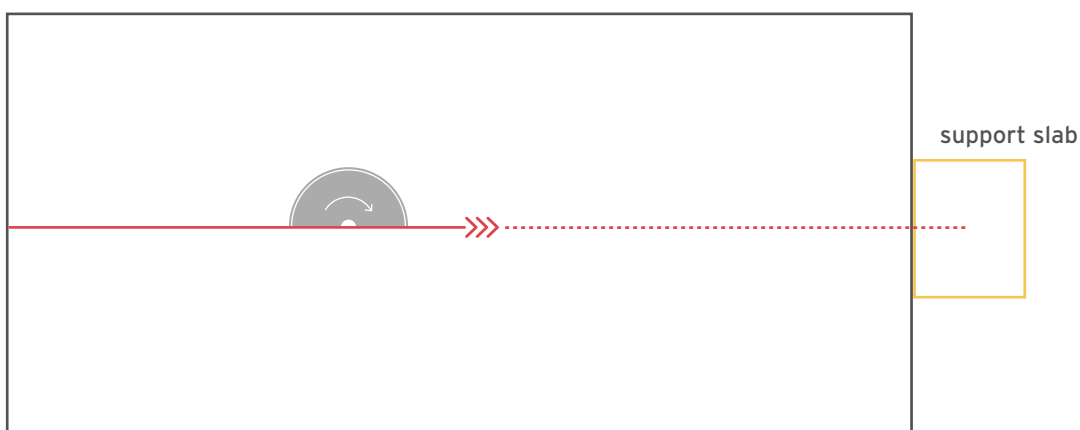


Slow the feed rate down to 50% for the first 20 cm and the last 20 cm.



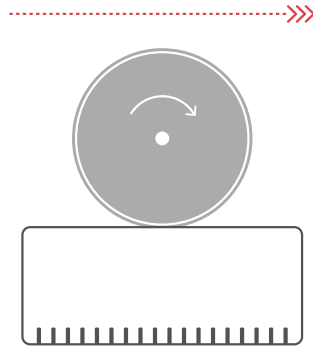
| ∅ Disc | Spindle revolutions rpm | Cutting Sped m/min |
|--------|-------------------------|--------------------|
| 250 mm | 3000 | 0,7 |
| 300 mm | 2600 | 0,8 |
| 350 mm | 2200 | 0,8 |

It is recommended to put an extra supporting material (e.g. smaller slab / waste slab) at the end of the slab cutting line, to avoid unwanted chipping. Then continue the cutting towards the support slab.



Blade Sharpening

The single most important maintenance procedure of a cutting blade is regular sharpening. Before using a new blade, it has to be sharpened first by spinning the blade through the brick's surface in order to remove the rough part of the blade.



* Blade must be in a horizontal position

Step Cutting

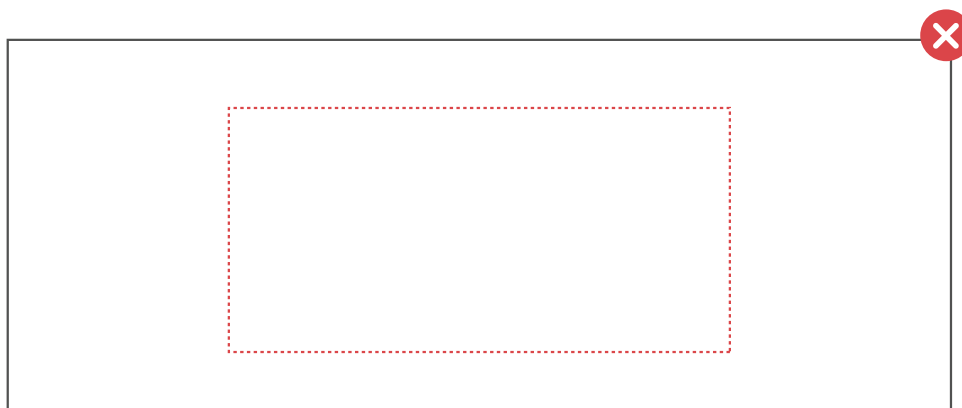
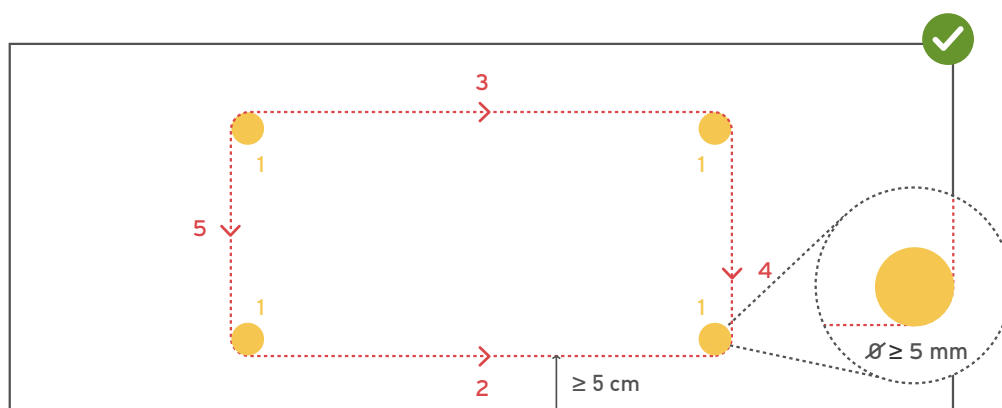
It is recommended to perform a step cutting in order to reduce the risk of breakage and chipping during cutting and to have a better edge finish.



1. Cut the slab only down to half of the thickness
2. Cut through all the way the thickness of the slab in the same direction with the 1st cut

Sink Cut-out

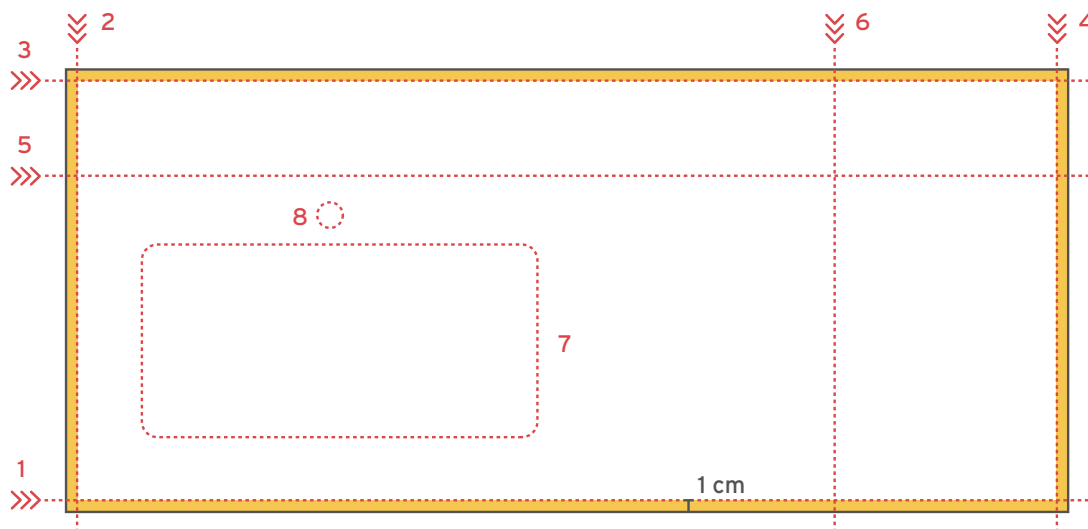
It's recommended to follow the steps below



- 1 Hole drilling
- 2-3-4-5 Interrupted cuts

Processing with Water Jet

Make sure that the cutting table is straight, level and free of any debris, and that there is enough support for the slab.



1-4 Slab Trimming

5-6 Countertop Perimeter Cuts

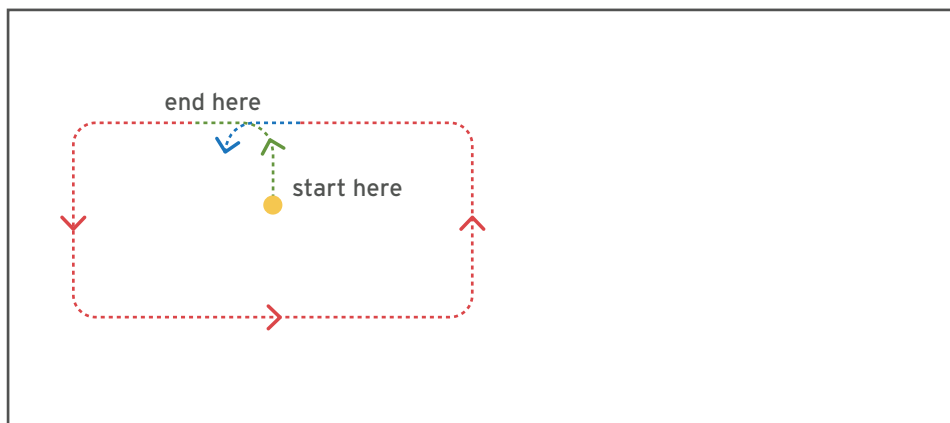
7 Sink Cut-Out

8 Hole Drilling

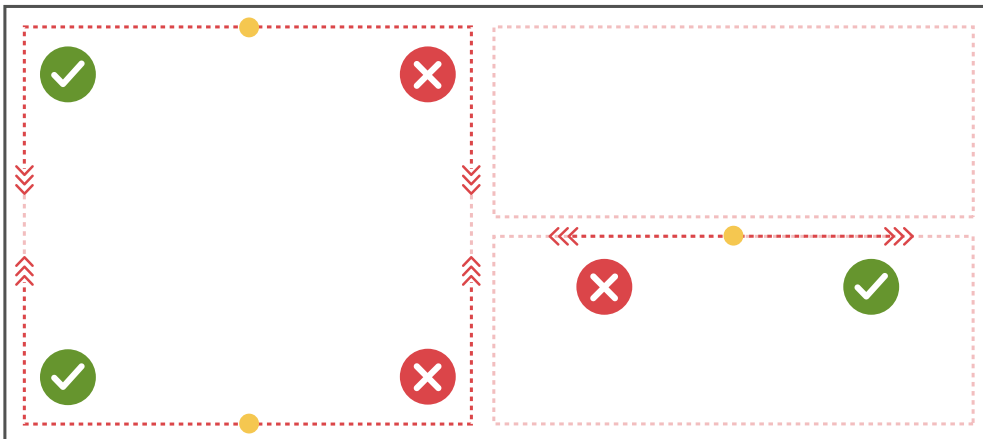
* All inner corners require a minimum radius of 5 mm

Lower pressure is recommended for drilling holes.

To do the cutouts, start the cut at an internal point in the cutout and then getting closer to the perimeter cut.



To do large cutouts or large parts, it's recommended to cut from the center of the cut-out towards the outside.



* First cutting starts from the hole to the edge of the slab and following this direction to finish the part.

Low pressure entry hole piercing parameters

| Thickness | Min. pressure Bar | Min. pressure Psi | Abrasive 80 Mesh lb/min |
|-----------|-------------------|-------------------|-------------------------|
| 12 mm | 600 | 8.700 | 0,77 - 0,99 |

* Make the entry hole minimum 5 mm away from the cutting perimeter.

High pressure cutting parameters

| Thickness | Min. pressure Bar | Min. pressure Psi | feed rate inch/min | Abrasive 80 Mesh lb/min |
|-----------|-------------------|-------------------|--------------------|-------------------------|
| 12 mm | 3.600 - 3.800 | 52.200 - 55.100 | 19,7 - 35,5 | 19,7 - 35,5 |

*The data shown are the maximum recommended values.

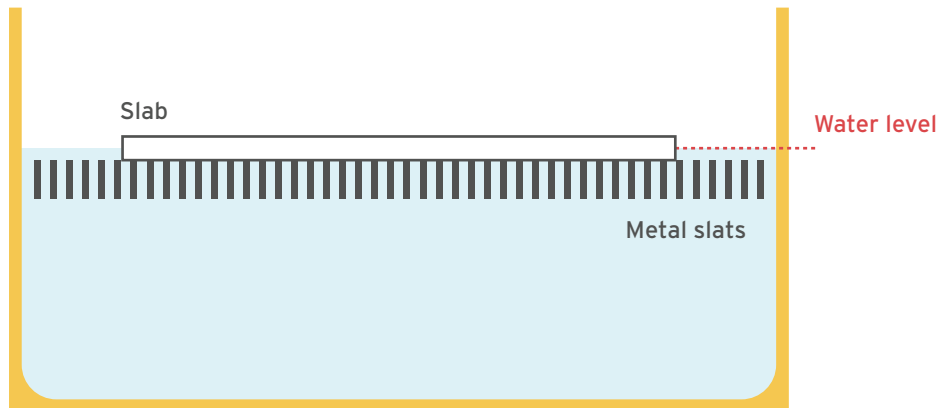
Lower the feed rate parameters to achieve a better finish.

For angles equal to or less than 90° it is recommended to round the corner with a radius min. 5 mm.

Remove any deep indentations using a diamond pad.

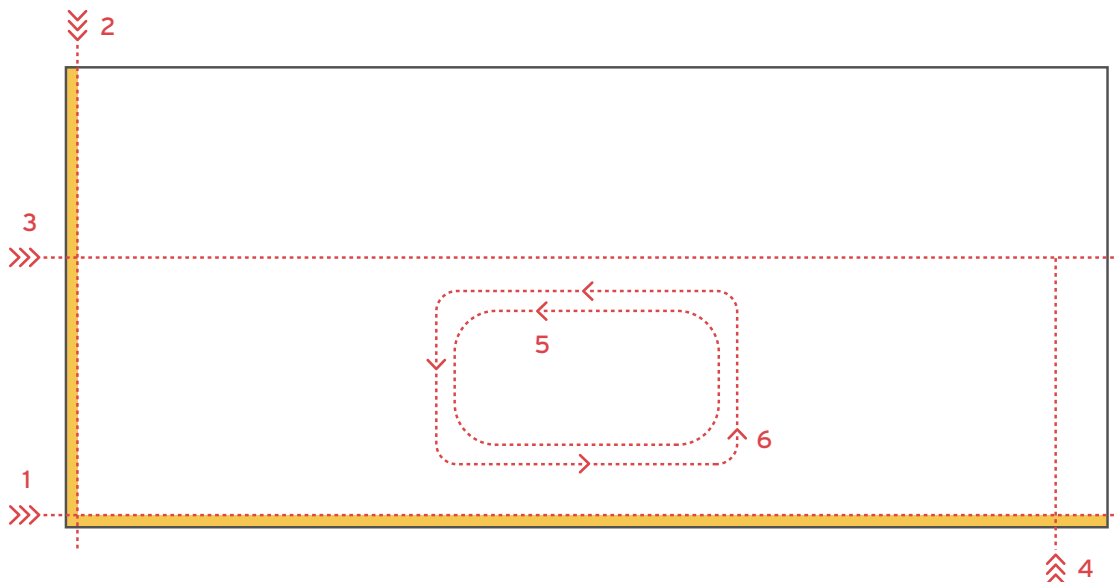
Water Level in Tank

It is recommended to keep the water level higher than or at the same level as the bench surface.



Sink Cut-out

It is recommended to perform a sink pre-cut to reduce the weight and stress of the cut-out.



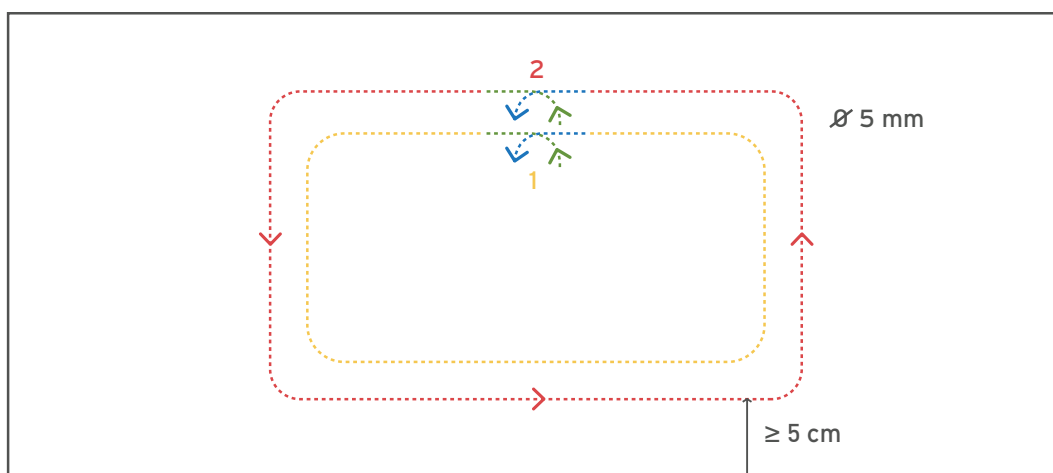
1-2 Slab trimming

3-4 Countertop perimeter cuts

5 Sink pre-cut (recommended)

6 Sink cut

The sink pre-cut must begin inside the sink cut.



1 Sink pre-cut

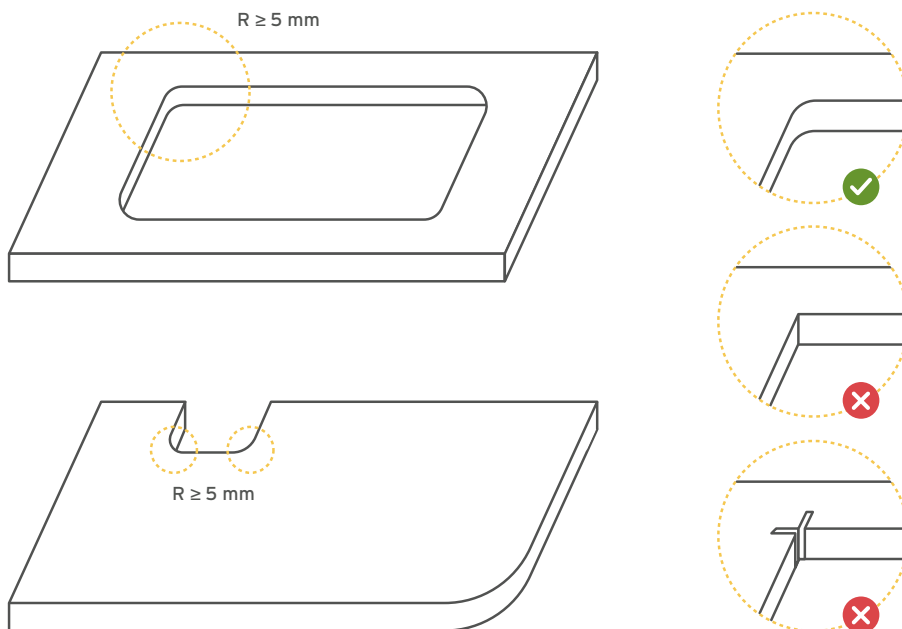
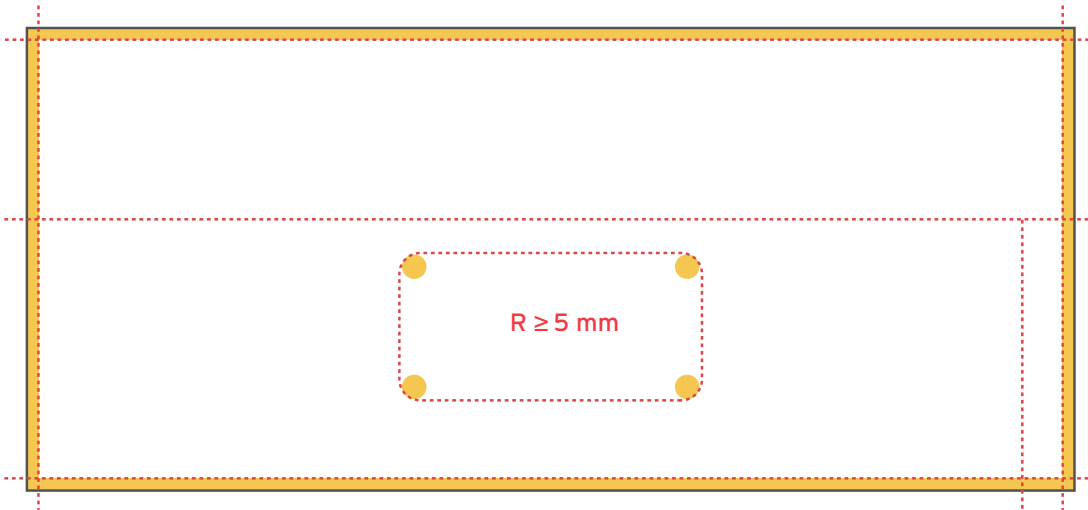
2 Sink cut



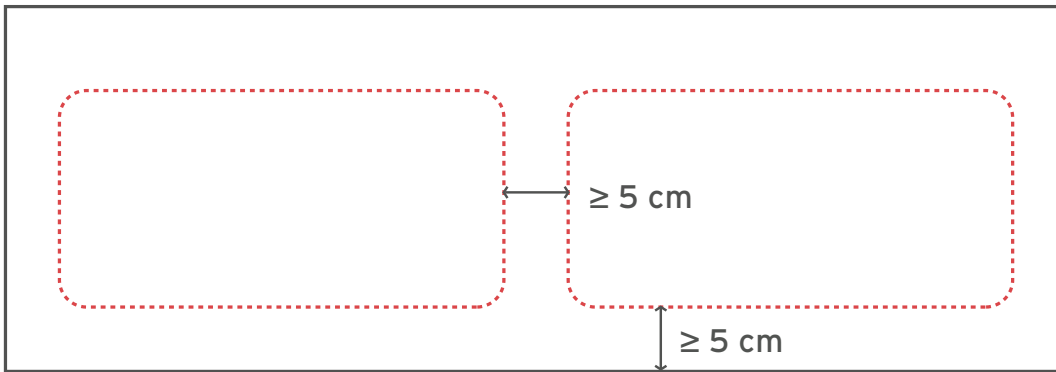
CORNERS & EDGES

Angular Corner

There must be a min. 5 mm radius for each angular corner created. This 5 mm radius corner can be created by drilling a hole or by water jet. This is to avoid cracking resulted from the stress due to sharp corner.



The must be a 5 cm minimum distance between cut-out and cut-out and between edge and cut-out.



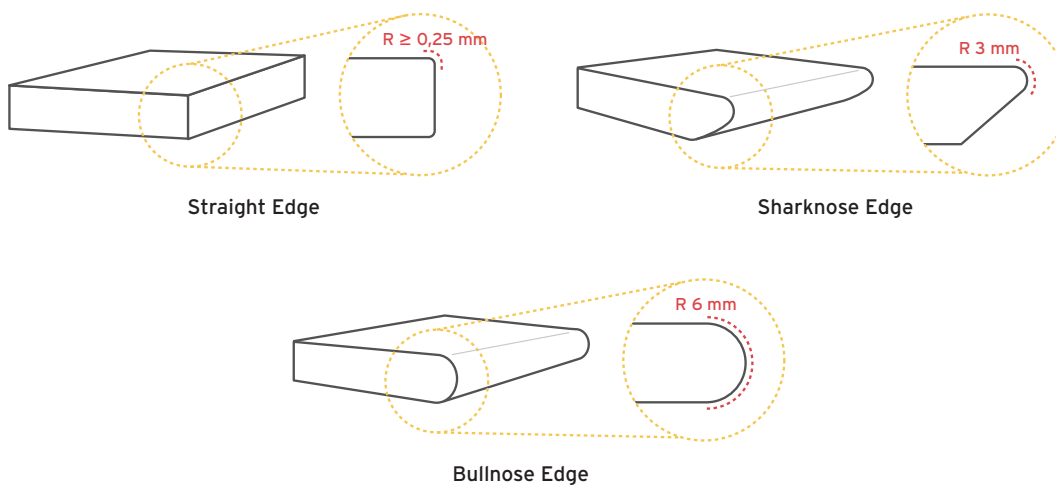
Edges

These recommendations are good balance between aesthetics and functionality for 12 mm thick slab while also guaranteeing a considerable reduction of damages with the product.

There are 4 recommended types of edges: straight edge, sharknose edge, bullnose edge, and mitered edge.

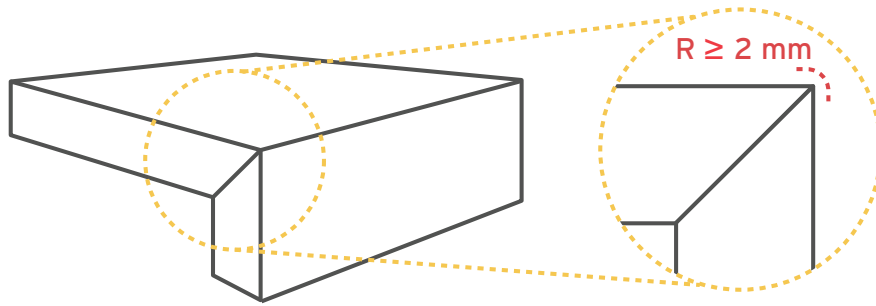
Straight, Bullnose and Sharknose Edge

It can be fabricated by CNC machine provided with different grinders. The polishing can be done using a sequence of abrasive increasing diamond grinders, or by CNC machine.



Mitered Edge

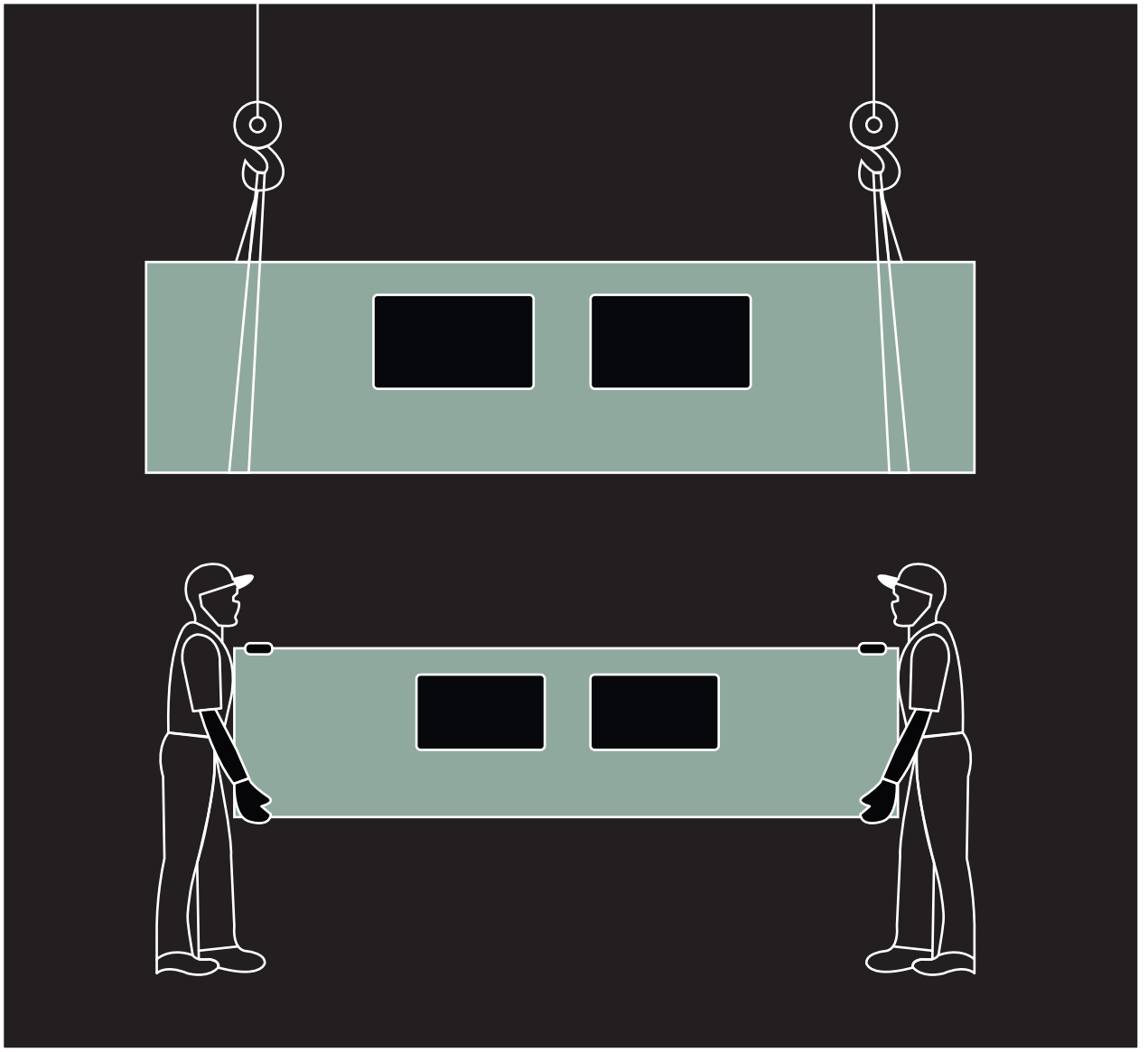
Mitered edge is formed by fusing together 2 pieces of 45 degree cut angles, using epoxy resin adhesive. Allow time for the resin to cure (as per resin manufacturer instruction)



5. INSTALLATION

5.1. On-site handling

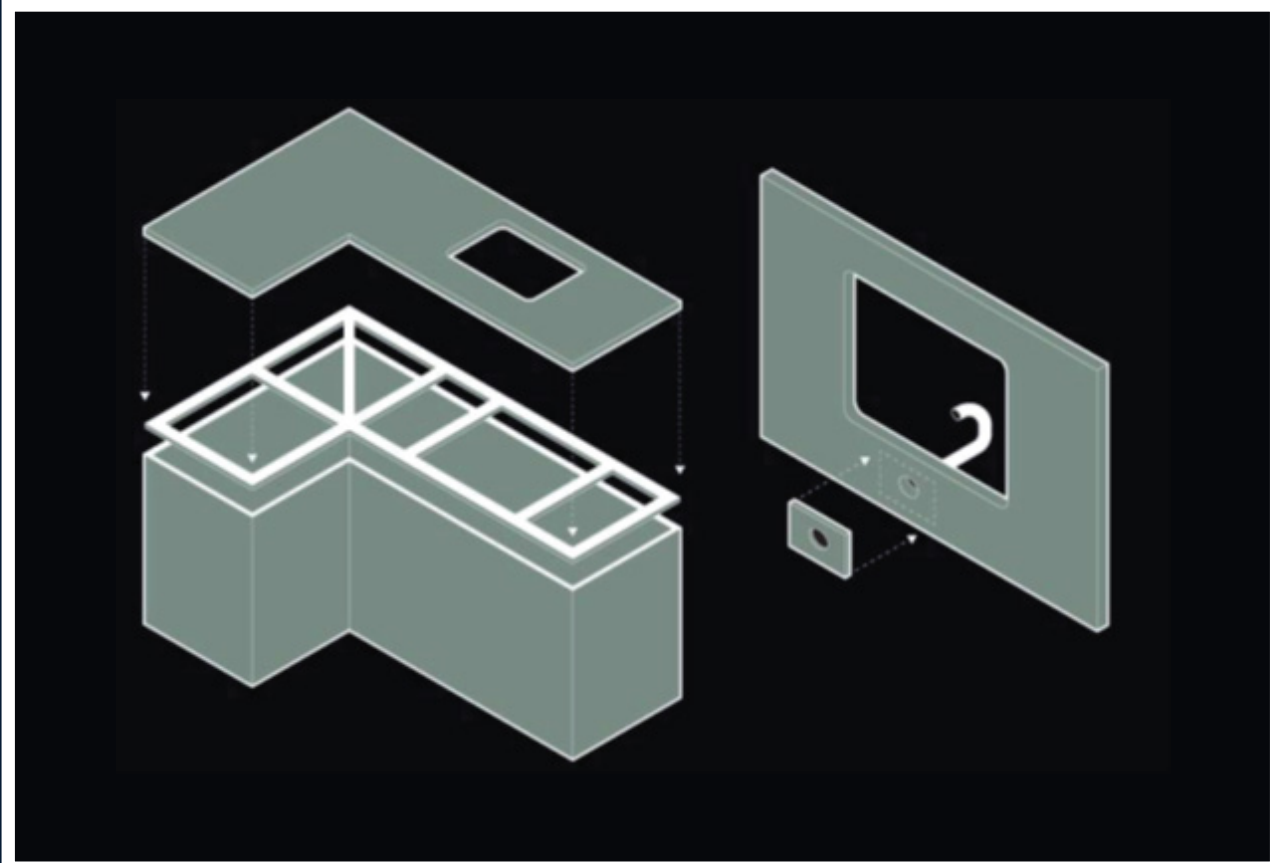
The slabs must be in a vertical position while being moved around at the installations site. If there are any cut-outs, they should always be facing upwards while being transported.



5.2. Laying

- Before laying the slabs, ensure that the surface is smooth without any debris and it is completely leveled and even.
- It is also recommended to ensure that there is 2 mm distance between any two slabs or with another surface.

- If there are any cut-outs in the slab, they should be supported near the joints and the surface. Any fittings on the slab such as taps, must also be supported at the drilling site with a reinforcing pad.



5.3. Gluing

It is recommended to use two component epoxy adhesive similar to the base color of the slabs.

- Always clean the surfaces that are to be glued properly. Ensure that they are dried evenly.
- Attach tape on the outer sides of both surfaces to be glued.
- Follow the glue preparation instructions closely. Parameters such as mixing ratio and hardening time may vary depending on the supplier.
- After gluing the two surfaces firmly together, mask the bonded edge with tape prior to grinding / polishing the edges.

5.4. Floor installation

Clean the area from all impurities (sand, wood chips, plastic, liquid). Use a level to ensure that the area is completely flat.



Cover the area to be installed with adhesive dough using 10mm trowel. Adhesive thickness should be even on all sides. The adhesive dough strokes should be parallel to the short side of the slab.

Coat the back of the slab with the adhesive dough using a 4 mm trowel. The adhesive dough stroke should be parallel to the short side of the slab.



Pat the surface of the slab using a rubber beater. It is to ensure that the adhesive mixture is solid and to avoid the existence of possible air pockets between the slab and the floor.



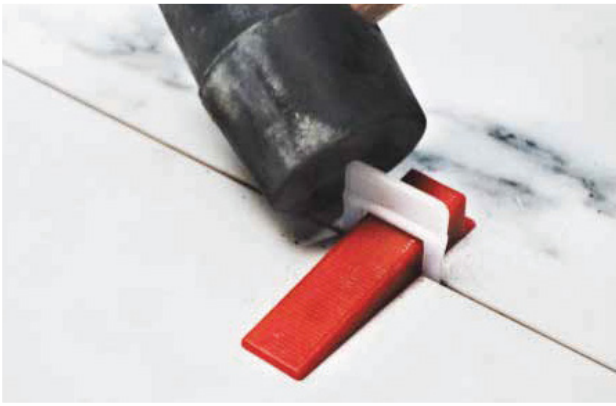
Insert the spacers next to the slab. Then proceed with the previous steps with the second slab to place them next to each other.

Use the tool (see image below) to pull slabs closer to each other while keeping the spacers in between.



Slide in the leveler in the spacer that has been installed earlier. This is to make sure that the surfaces of the slabs are aligned. The leveler is locked using special clamping pliers.

Use a level to ensure that slabs are all aligned. After the adhesive dough dries (minimum 24 hours), remove the spacer and levels by using rubber hammer in a horizontal direction.



Properly grout between the slabs. Then, clean the residue from the surface of the slab with a wet foam.

5.5. Wall Installation

Clean the area to be installed and check with a level.

Adhesive preparation: Pour adhesive into a container (bucket), mix with clean water (according to instructions on the packaging of the adhesive) using a mixer for +/- 10 minutes.



Cover the wall where the slab will be installed with adhesive dough using 10mm trowel. The adhesive dough strokes should be parallel to the long side of the slab. Use anchors for installations above 3 meters and outdoor applications.



STEP 1

Place the slab to be installed on the trolley (back side of slab facing forward), then coat the back of the slab with adhesive using a 4mm trowel. The adhesive dough stroke should be parallel to the short side of the slab.

STEP 2

Lift the slab that has been coated with adhesive onto the wall and glue the two sides that have been coated with the adhesive. Use the tool (see image below) to pull slabs closer to each other while keeping the spacers in between.



STEP 3

Pat the surface of the slab using a rubber beater to ensure that the adhesive mixture is solid and no air is trapped between the slab and the wall.



STEP 4

Install the spacers between the slabs.

Follow the previous steps (1-4) for the next slab. Then, install the tool (as shown in images above) to bring two slabs together while keeping spacers in between.

Slide in the leveler in the spacer that has been installed earlier. This is to make sure that the surfaces of the slabs are aligned. The leveler is locked by using special clamping pliers.



After the adhesive dough dries (minimum 24 hours), remove the spacer and levelers by hitting the spacers and levelers with a rubber hammer vertically.

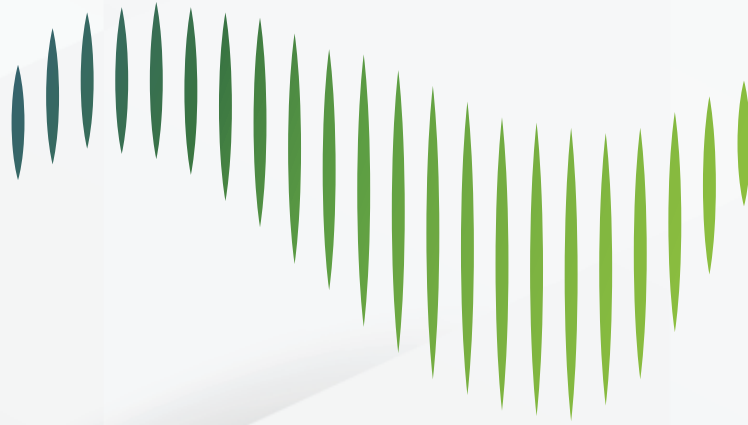
Fill between the slabs with the grouting material evenly. Clean the surface of the slabs with a wet foam.

Liability Waiver

This manual has been created to offer informative guidelines for the design, fabrication, and installation of Northern Lights Porcelain products.

Depending on the type of equipment and materials used, optimum settings may vary for each fabricator. Please consult with your material and equipment suppliers for the most suitable settings.

The information provided is merely informative and the customer must review it thoroughly prior to proceeding with installation.



NORTHERN LIGHTS

— *Porcelain* —

WWW.NLPORCELAIN.CA

EMAIL : SALES@NLPORCELAIN.CA