Introduction to the GCTechnologyFolder

The GCTechnologyFolder provides the information needed for using graphic concrete products in prefabrication production.
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Industrially produced inspirational environments

Graphic Concrete Ltd manufactures and sells an innovative product known as graphic concrete. It enables durable patterns and images to be produced on prefabricated concrete surfaces such as facades, walls and pavement slabs. Graphic concrete is a patented technology invented by interior architect Samuli Naamanka. The inspiration was to create a real industrial product for large-scale surfaces, a tool with which architects could be more visually creative.

Since the late 1990s we have been working around the world with projects ranging from industrial buildings to fine art. Today, graphic concrete is a proven technology within the global concrete prefabrication industry. An extensive number of reference buildings demonstrate the vast range of building designs in which graphic concrete can be used. Our goal is to enable architects and designers to turn their visions into reality. Our products can be tailored, and the outcome of each project is unique. We believe in building a better environment through the use of graphic concrete.
Products

Our end product is a membrane used in the prefabrication process of concrete. Our patented products enable patterns and images on prefabricated concrete surfaces such as facades, walls and pavement slabs. The desired image is printed on the membrane with a surface retarder, after which the membrane is sent to the local concrete prefabrication company. Concrete is cast on the membrane and when the retarder is washed away the image is revealed. The pattern results from the contrast between the fair face and the exposed aggregate surface: the stone colour and cement colour. The outcome may also be completely smooth (fair face).

Changing the aggregate and/or cement colour offers a vast amount of variations in the outcome.

Being a standardised part of the prefabrication industry, graphic concrete is easy to use. The cost effectiveness is obvious: the surface is ready as such and needs no more cladding.

Exposed aggregate + fairface = graphic concrete

GCCollection™  
GCCollection™ is our own range of ready-made design patterns.

GCSmooth™  
GCSmooth™ gives a beautiful velvety smooth and even concrete surface without pattern.

GCPro™  
GCPro™ represents unique patterns designed by architects and designers to match a specific project.

GCArt&Design™  
GCArt&Design™ enables you to transfer artwork or photographical images to concrete surface.
Graphic Concrete’s way of working

We co-operate within the entire chain of construction: we provide design support to architects and designers and technological support to the concrete element industry.

Illustration: Graphic Concrete’s way of working
In Brief: Using graphic concrete

A typical project flow is as follows: an architect designs their own pattern, or selects one from our GCCollection™. We print the pattern onto a membrane with surface retarder and then send the membrane to the concrete prefabrication company. The concrete is cast on the membrane and the elements are transported to the building site for construction.

Illustration: The production process

1. An architect designs their own pattern or selects one from GCCollection™. The designer sends the pattern to Graphic Concrete.

2. Graphic Concrete prints the pattern onto a membrane and then sends the membrane to the concrete element manufacturer.

3. The membrane is placed on the bottom of the mould.

4. Concrete is poured into the mould on top of the membrane.

5. The membrane is removed from the surface of the element the next day.

6. The surface of the element is washed with a high-pressure cleaner.

7. The cast element complete with a graphic concrete pattern.
Benefits of using graphic concrete

Graphic concrete:

- increases the quality and the value of concrete element construction. We help create exciting architecture. Graphic concrete enables even uniquely designed patterns on large surfaces.
- is cost-effective and easy to use despite its uniqueness. It is very suitable for concrete element production processes in which special attention is paid to overall profitability.
- patterns are produced without increasing the weight of the concrete element.
- reduces the use of solvent-based materials in prefabrication (compared with producing a fine exposed aggregate finish by painting the mould with a solvent-based conventional surface retarder).
- reduces dust inconvenience in the cleaning of the mould phase.
- reduces retarder waste in wash sludge compared with conventional methods.

Cost-effective Technology

Graphic concrete technology enables the cost-effective and high-quality production of patterned concrete surfaces. The results below were achieved by Consolis Technology together with Graphic Concrete Ltd.

The production of exposed aggregate finish with traditional methods requires over 25% more working time than with graphic concrete technology.

Illustration: Graphic concrete is a cost-effective solution
1 Before using graphic concrete products

The graphic concrete manufacturing process is basically the same as with a fine exposed aggregate surface produced by a liquid retarder. A dry special retarder membrane is placed on the bottom of the mould, and the concrete is cast on the membrane. The actual pattern on the surface of the concrete results from the contrast between the exposed and smooth concrete finish.

1.1 Basic requirements for a prefabrication company

- Participation in GCTechnologyTraining
- All instructions must be carefully studied and followed
- Knowledge and facilities to produce fine exposed aggregate concrete surfaces
- Facilities and equipment to use high-pressure washing with water
- High-quality moulds for horizontal casting
- The use of a vacuum table is recommended (see: 3.2 Vacuum Table)

GCTechnologyTraining helps ensure the effective and high-quality production of graphic concrete.
Testing is important as the raw materials and the production conditions are factory specific.

Horizontal casting is used for casting graphic concrete.
1.2 Preparations before receiving the first delivery

- Carefully study the instructions (2.5 Storing and handling the membrane and 3. Necessary tools and equipment for production).
- Plan in advance how to store, move and handle the membrane according to the instructions.
- Arrange all the necessary tools and equipment for storing and handling the products.

**Note:** The warranty and the responsibility of Graphic Concrete Ltd is restricted to the quality of the products it has delivered. If a client alters or modifies graphic concrete products or does not follow the instructions, the warranty given by Graphic Concrete Ltd does not apply anymore. Alteration or modification may include cutting shapes from the membrane or attaching objects, such as stickers, to the membrane. (see: Attachment 1 Product Warranty and Liability).

1.3 Validating new concrete recipes and production processes

The exposure outcome needs to be tested using Test 1 and Test 2 (below) before changing the raw materials, recipe, concrete product type, production process or any other variable.

**Test 1:** Test graphic concrete products with different recipes
- Cast sample slabs (see Instructions: 5.1 Casting sample slabs).
- Send images of the test results to Graphic Concrete.
- Discuss the results with your contact person at Graphic Concrete.
- Pay attention to the following issues:
  - The exposure depth
  - The sharpness of the line between the exposed and the smooth areas
  - The image contrast and colours
  - Remember to distinguish between different surface retarders

**Test 2:** Test how fast the surface retarder starts acting with different recipes
- Prepare three sample size moulds on separate mould tables.
- Use the same graphic concrete pattern in each mould.
- Cast each mould with the same recipe.
- Compact one mould after 5 minutes, one after 10 minutes and one after 20 minutes starting from pouring the concrete into the mould.
- Demould and wash normally the day after.
- Pay attention to the following issues:
  - The sharpness of the line between the exposed and the smooth areas
  - The existence of so-called “shadows” next to the exposed areas
  (see: 7. Practical advice for successful casting)
Carry out tests if a new concrete recipe is introduced or any change in the production process or conditions is applied.

**Note:** When testing graphic concrete and casting sample slabs, remember to simulate your real production as much as possible. For instance, place insulation on top of the slabs to increase the temperature and use the normal time between casting and compacting of concrete.

Our instructions for recipes and production processes are guidelines only. All new recipes, production processes and conditions need to be tested in real production conditions.

The four main factors affecting the outcome are:

1. the graphic design
2. the retarder used
3. the concrete recipe and;
4. the production process at the prefabrication company

The retarder is marked on the sample membranes.
2 Products

Our patented products enable patterns and images on prefabricated concrete surfaces such as facades, walls and pavement slabs. We print the pattern onto a membrane with surface retarder and then send the membrane to the concrete prefabrication company. Concrete is cast on the membrane. The pattern results from the contrast between the fair face and the exposed aggregate. The outcome may also be completely smooth (fair face).

2.1 Designs / Patterns and images

We provide a range of ready-made repetitive patterns (GCCollection™) or clients can design their own unique repetitive pattern (GCPro™). It is also possible to transfer artwork or graphic images to the concrete surface (GCArt&Design™). For a velvety smooth concrete surface without a pattern, the right choice is GCSmooth™.
2.2 Surface retarders

We offer three different types of retarders:

- **GC-SK0030**  For cements with Na2Oeqv > 0.6% (the weakest retarder)
- **GC-SK0100**  For cements with Na2Oeqv < 0.6% (middle effect retarder)
- **GC-SK0150**  For cements with N2aOeqv < 0.6% (the strongest retarder)

All graphic concrete surface retarders produce a fine exposed aggregate surface (exposure 0.5 mm – 1.5 mm); the differences between the surface retarders are relatively small. The main reason for providing different surface retarders is not to produce different exposure depths but to help produce a good quality concrete surface with a clear exposure of aggregates and sharp pattern lines.

**Note:** The above recommendations for choosing retarders are guidelines only. All new recipes, production processes and conditions need to be tested with casting simulating real production conditions. Note that the result can vary between small test slabs and large production elements.
2.3 Membrane

Measurements of the membrane and the freight package

Unless otherwise specified, the membrane is delivered on a roll with the following specifications:

<table>
<thead>
<tr>
<th>A Full size roll</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>W Width (without internal pipe)</td>
<td>3300 mm</td>
</tr>
<tr>
<td>Width (with internal pipe)</td>
<td>3300 mm</td>
</tr>
<tr>
<td>D Outer diameter</td>
<td>410 mm</td>
</tr>
<tr>
<td>d Inner diameter</td>
<td>153 mm</td>
</tr>
<tr>
<td>Weigh</td>
<td>310 kg</td>
</tr>
<tr>
<td>Total amount of membrane</td>
<td>330 linear meters</td>
</tr>
</tbody>
</table>

Note: At the end of the roll there is more than 10 metres of smooth membrane without any pattern. This needs to be taken into account when assessing the amount of patterned membrane left on the roll.
The patterned area and the margin area on the membrane

Our products contain: 1) the patterned area on which the concrete is cast, and 2) the margin area that will not be visible on the concrete product. If needed, the margin area can be used for printing of marks, notations and instructions which assist with the use of our membrane during the panel/element fabrication process. Please contact your Graphic Concrete representative if you would like to have marks or instructions printed in the margin area.
2.4 Packaging

The membrane rolls are normally delivered in a wooden box (size approximately 355cm x 60cm x 70cm).

For orders with less than 50 linear metres, the membrane is delivered in a tube (size approximately 340cm x 30cm).
2.5 Storing and handling the membrane

Before storing the delivered membrane, inspect the delivery to ensure that the products are not damaged and that the delivery corresponds to the order. A packing list is attached to each package.

Storing

Requirements for the storing conditions:
- Dry conditions (relative humidity under 50%)
- Warm conditions (temperature +15°C - +40°C)
- No direct sunlight to the membrane
- Keep the membrane clean: do not allow the membrane to become dusty, dirty, wet or covered with oil
- Use appropriate equipment (see instructions: 3. Necessary tools and equipment for production)
- Keep the membrane in the original delivery package until using it
- Prevent all compression to the membrane roll
- Products must be used within 12 months of delivery. After 12 months, we cannot guarantee that the membranes will still function.

We recommend a roll rack for storing the membrane rolls efficiently and safely.
Handling

No changes are allowed to the product due to handling.

Handle the membrane with care so that:
  • no wrinkles, creases or ruptures will appear
  • the membrane will stay clean

If it is necessary to cut the membrane, we recommend cutting the same day as casting.

Cutting the membrane on a clean separate table.

Reroll the membrane after cutting and move it further in a roll to avoid wrinkles or creases.

Note: Any problems or damage caused by improper storing, handling or using the products, using the products for any other purpose than the application specified, altering or modifying the products (e.g. cutting shapes of the membrane or attaching objects, such as stickers, to the membrane), natural disasters or other such circumstances shall not be governed nor covered by the warranty given by Graphic Concrete Ltd.
2.6 Safety, disposal and environmental issues

**Work safety:** Graphic concrete membranes do not emit any harmful gas or chemicals (see: Attachment 2. Declaration of Graphic Concrete products).

**Disposal:** The membrane is for single use only. The used membrane may be disposed of in three alternative ways: 1) as mixed waste, 2) burnt in an appropriate manner, or 3) washed and recycled.

**Environmental issues:** The use of the membrane is not known to have any effect on the environmental loading of a building in use or the age of the building.

> Dispose the membrane to mixed or energy waste to be burned.

In a study jointly conducted by Consolis Technology and Graphic Concrete Ltd, the environmental and industrial safety benefits of using graphic concrete technology over traditional liquid surface retarders are:

1. Reduced use of solvent-based materials in prefabrication (compared with producing fine exposed aggregate finish by painting the mould with a solvent-based conventional surface retarder)
2. Reduced dust inconvenience in the cleaning of the mould phase
3. Reduced retarder waste in the wash sludge compared with conventional methods
4. Increased mixed waste material (membrane)

Please see also the Declaration of Graphic Concrete Products (Attachment 2).
3 Necessary tools and equipment for production

3.1 General

Storing

- Roll rack: for safe storage and efficient use of the membrane
- Protection tarpaulin: to protect the membrane in the factory

Moving

- A crane
- A lifting bar
- Spreading frames

Handling and using

- Clean shoe covers for walking on the membrane
- An industrial vacuum cleaner for removing dust from the mould table
- A clean cutting table or mould table for cutting the membrane
- A cutting knife for cutting the membrane
- A ruler or equivalent for measuring and straight edge cutting of the membrane
- A soft and clean brush for light cleaning of the membrane and for sweeping and pressing the membrane against the mould table
- A 1-2 mm thick piece of plastic plate or equivalent for cutting a straight section around the reservations and mould edges if no vacuum table is used. You may also precut the membrane in the correct size in a separate cutting place.
- A vacuum table is recommended (see Instructions: 3.2 Vacuum table).

Recommended tools required for production.

Note: The equipment needed may vary according to the production facilities.
3.2 Vacuum table

We recommend the use of a vacuum table when using graphic concrete technology. The return on investment is normally fast as the advantages are clear.

The vacuum table is a separate plane that is installed on a normal table mould. It makes the membrane flat as it removes the air between the membrane and the table surface. After use the vacuum table can be removed and the mould can be used again for casting normal concrete elements.

**Advantages of using a vacuum table**

**Better cost efficiency:**
- Easier handling of the membrane
- No need for gap of 1–2 mm by the edges, openings and recesses
- Faster production process
- Less quality defects and waste concrete elements

**Better quality:**
- Corners look better because the membrane continues under the mould edges
- Prevents concrete from flowing under the membrane
- Effective methods and equipment improve job satisfaction

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**Recommended Specification: Construction of a vacuum table**

The plane is composed of two steel plates and a structure in between. The vacuum is generated in the plane by connecting the plane to the factory vacuum system. The technical requirements are as follows:
- Surface steel plate with a normal levelling tolerance and minimum thickness of 8 mm
- Air holes on the surface steel plate (D = 3 mm with a maximum distance c/c of 200 mm)
- Bearing profile steel construction between the plates
- Bottom steel plate
- A separate industrial vacuum cleaner or a central unit
- The vacuum table is mechanically locked to the mould
- Lifting hooks for handling the vacuum table

**Tip:** If the bottom steel plate is thick enough and the surface quality high enough, the vacuum table can be turned around and normal concrete panels can be cast on the bottom steel plate.
The vacuum is generated by a factory vacuum system or by an industrial vacuum cleaner. A vacuum capacity of 300 m³/h or the vacuum of 2 m water pillar is sufficient.

Using a vacuum table

- The vacuum table can be stored vertically when it is not used.
- It can be moved with the help of a traverse.
- The vacuum table is mechanically fixed to the mould.
- The graphic concrete membrane is spread on the mould.
- The vacuum is turned on.
- The vacuum is closed from the uppermost cell lines that are not needed (holes are covered).
- The holding power of the magnets decreases by about 40% if placed on the membrane.

Please study the instructions 5.2 Using the technology in a prefabrication plant (with vacuum table).
4 Concrete recipes

These instructions contain general guidelines for recipes and some examples of mix designs used with graphic concrete. However, we encourage you to first test and use your existing recipes and only fine tune those mixes if necessary.

**Graphic concrete technology can be used with many different recipes, including the following:**

- Traditional reinforced concrete with white and grey cement
- Self compacting concrete
- GRC (glass fibre reinforced concrete)
- (Ultra) high performance concrete

Guidelines for graphic recipes are provided below. Note that other recipes have also been successfully applied.

**Cement alkali contents:**

- Na$_2$O$_{eqv}$ < 0.6%: surface retarders GC-SK0100 and GC-SK0150 are recommended
- Na$_2$O$_{eqv}$ > 0.6%: surface retarder GC-SK0030 is recommended

| Fine material | < 550 kg/m$^3$, binders+powders < 0.125 mm |
| Aggregate gradation | Max size 16 mm |
| Grading curve | Continuous |
| Concrete admixtures | As usual |
| Min. temperature: | + 10 degrees centigrade |
| Max. temperature: | + 45 degrees centigrade |

In addition to the graphic concrete product, several other factors affect the exposure and the outcome of the final concrete surface. For example, according to our tests and practical experience, all the following conditions reduce the exposure depth:

- low water-cement ratio
- high temperature (mix proportion and production conditions)
- high specific surface area of the cement
- low alkali content of the cement
- high strength class of the concrete
- long de-moulding time (e.g. over the weekend)
- fineness of aggregate

**Note:** All the information in these instructions is based on laboratory tests and practical experience and is only indicative in nature. All graphic concrete products and the concrete recipes used need to be tested in real production by the producer of the concrete (Please also see instructions 1.3 Validating new recipes and production processes).
Some examples of graphic concrete recipes

Note: The following recipes are examples only and do not thoroughly represent all the different kinds of mix designs used for graphic concrete.

<table>
<thead>
<tr>
<th>Mix</th>
<th>Cement</th>
<th>Pigment</th>
<th>Aggregates</th>
<th>Water-Cement ratio</th>
<th>water W</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White cement</td>
<td>White limestone PKK 5-12 22R</td>
<td>White limestone PKK 0-2 22R</td>
<td>0.50 W/c</td>
<td>330 kg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Filler</td>
<td>170 kg/m³</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mix</th>
<th>Cement</th>
<th>Pigment</th>
<th>Aggregates</th>
<th>Water-Cement ratio</th>
<th>water W</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>White cement</td>
<td>Black pigment 318 C330</td>
<td>Black gabro 0-2 35R</td>
<td>0.50 W/c</td>
<td>360 kg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Black gabro 2-5 35R</td>
<td>188 kg/m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Black gabro 5-12 35R</td>
<td>188 kg/m³</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Mix</th>
<th>Cement</th>
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<th>Aggregates</th>
<th>Water-Cement ratio</th>
<th>water W</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Rapid cement (grey)</td>
<td>Gravel 0-8</td>
<td>Crushed Stone 4-12</td>
<td>0.45 W/c</td>
<td>380 kg/m³</td>
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<td></td>
<td></td>
<td>Filler</td>
<td>181 kg/m³</td>
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</table>

<table>
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<th>Pigment</th>
<th>Aggregates</th>
<th>Water-Cement ratio</th>
<th>water W</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>White cement</td>
<td>Brown pigment 686 0.2%</td>
<td>Taivassalo red granite 0-2 34R</td>
<td>0.51 W/c</td>
<td>350 kg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Taivassalo red granite 2-5 34R</td>
<td>187 kg/m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Taivassalo red granite 4-12 34R</td>
<td>187 kg/m³</td>
<td></td>
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<tr>
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<th>Cement</th>
<th>Pigment</th>
<th>Aggregates</th>
<th>Water-Cement ratio</th>
<th>water W</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>White cement</td>
<td>Green Gn pigment</td>
<td>Black gabro 0-2 35R</td>
<td>2%</td>
<td>350 kg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Black gabro 2-5 35R</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Black gabro 5-12 35R</td>
<td>19%</td>
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</table>

<table>
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<th>Cement</th>
<th>Pigment</th>
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<th>Water-Cement ratio</th>
<th>water W</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>White cement</td>
<td>Black pigment 318</td>
<td>Black gabro 0-2 35R</td>
<td>1%</td>
<td>350 kg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Black gabro 2-5 35R</td>
<td>1%</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Black gabro 5-12 35R</td>
<td>1%</td>
<td></td>
</tr>
</tbody>
</table>
5  Casting instructions

5.1  Casting sample slabs

All graphic concrete products and concrete recipes used need to be tested by the producer of the concrete in real production conditions using production size sample panels.

When testing graphic concrete and casting sample slabs, please remember to simulate your real production conditions as well as possible. For instance, place insulation on the top of the slabs to increase the temperature and use the normal timing between the casting and the compacting of concrete.

Storing and handling of membranes (see also: 2.5 Storing and handling the membrane)

- The membrane must be stored in a dry, warm space protected from sunlight, moisture, oil, dirt and dust.
- Handle the membrane carefully to prevent wrinkles or creases.

Preliminary tests and trial castings

- GCTechnologyTraining must be conducted prior to commercially using graphic concrete technology.
- The training includes trial castings using various concrete masses and membranes, as well as learning how to use the membrane in production.
- The training helps ensure a high-quality end result and production efficiency.

Preparations

- Sample slab production begins with cleaning the mould. The mould should have an even and clean surface. Even the smallest irregularities on the mould surface (for example, marks left by a hammer) will be imprinted on the concrete surface.
- Contaminants or particles between the mould surface and the membrane or blisters on the mould surface will be visible on the concrete surface.
- Use an industrial vacuum cleaner to remove all loose dust and sand particles. Do not use mould oil or release agents.

Setting the mould edges and building the mould

- Start by either 1) spreading a piece of membrane that is larger than the slab being cast over the mould table, or 2) precut a piece of membrane into the correct size and place it on the bottom of a finished mould.
- Press the membrane tightly against the surface of the mould table. As little air as possible should remain between the membrane and the table surface.
- Set the mould edges on the membrane and lock them to the mould table.
Casting and compacting the slab

- Use external vibration for compacting the slab in the normal way. Use sufficient compacting time but keep it as short as possible. Self-compacting concrete may also be used.

Exposing the graphic concrete pattern

- The membrane is removed and the sample slabs are pressure washed the following day

If you need more instructions for the production, please see 5.2 and 5.3.

**Note:** The exposure of the aggregates in small slabs may not be consistent with the final, or production sized elements due to the differences in sizes, temperatures, timings, mix design and other variables in the production conditions.

Series of sample slabs of Round Rough from our GCCollection™.
5.2 Using the technology in a prefabrication plant (with vacuum table)

The graphic concrete process produces a fine exposed aggregate surface on a concrete element in a more efficient, cost-effective and safer way than traditional liquid surface retarders. A dry special retarder membrane is placed on the bottom of the mould and concrete is cast on the membrane. The actual pattern on the surface of the concrete results from the contrast between exposed and smooth concrete finish.

The production process for the elements is similar to that used for producing traditional exposed fine aggregate finishes.

Read all the material in the GCTechnologyFolder before using graphic concrete in production.

Preliminary tests and trial castings

- You need to perform preliminary tests and tasks prior to commencement of the production using graphic concrete technology (see: 1. Before using graphic concrete products).
- The preliminary tests include trial castings using various concrete recipes and membranes, as well as learning how to use the membrane in production. This helps ensure quality and production efficiency.

We provide cast-ready printed membrane sample kits (GCTube) for preliminary testing.
Preparations

- Use the best possible mould surface under the membrane.
- Even the smallest irregularities in the mould surface (for example, marks left by a hammer) are imprinted on the concrete surface.
- The vacuum table is mechanically fixed onto a normal mould.
- The vacuum for the uppermost corrugations, which are not needed, is switched off or the holes are covered, for example with a left over piece of membrane.
- Element production begins with cleaning the mould. Contaminants or particles between the vacuum table surface and the membrane or blisters in the vacuum table surface will be visible in the concrete surface as a larger depression.
- Turn the mould heat off.
- Level the vacuum table surfaces carefully using a sanding machine and a pestle.
- Use a vacuum cleaner to remove all loose dust and sand particles.
- Always remove all contaminants and sharp edges from the table surface prior to spreading the membrane.
- Do not use mould oil on the surface.
Spreading the membrane on the vacuum table

- Spread the membrane onto a clean vacuum table and place it in the correct position. Please note that there may be crop marks and instructions printed on the membrane margin.
- Check the correctness of the pattern or image being printed on the membrane prior to continuing work.
- Do not use a defective or damaged membrane for producing a concrete product.
- If it is necessary to walk on the membrane, use shoe covers.
- Turn the vacuum on. To produce the vacuum, a normal industrial vacuum cleaner is sufficient.
- Before setting the edges, check that the membrane is set tight and straight against the surface of the vacuum table. You can perform this procedure by using a soft brush and pulling the ends of the membrane to straighten it.
- Check there are no contaminants between the left between the table surface and the membrane
- If necessary, remove the contaminants.
Setting the mould edges and building the mould

- Set the edges of the mould on the membrane and lock them to the vacuum table.
- If necessary, cut the membrane under magnets.
- Set up the equipment for the mould in the right places and attach to the mould surface with magnets or by supporting them over the edges.
- Check the correct placement and dimensioning of the membrane before proceeding.
- The vacuum is on during the whole casting process.

Set the edges of the mould directly onto the membrane.

Reinforcing the element

- Reinforce the element normally, being careful not to damage the membrane.
- Place the spacers on the membrane.
- Lift the reinforcements onto the membrane and the spacers and tie them into place. Be careful not to damage the membrane during reinforcement.

Normal reinforcement and spacers are used with graphic concrete.
Casting and compacting the element

- Begin casting by carefully pouring the concrete onto the mould from a short distance above the membrane surface. You can also pour the concrete via a board laid over the edges or on top of the reinforcements. Avoid pouring the concrete mass from too great a height because it may damage the membrane.
- After starting the casting, pour the mass from the container into the mould from as low a height as possible on top of the already cast concrete face.
- Use external vibration to compact the element in the normal manner. Use sufficient compacting time but keep the time as short as possible.
- If using a poker vibrator to assist compacting, do not allow it to penetrate to the bottom of the mould.
- Keep the time between casting and compacting short enough to avoid spreading of the surface retarder and the pattern.
- Finish the cast surface in the normal manner.
- Turn the vacuum off.

Pour the concrete mass carefully near the membrane surface.

Keep the time between casting and compacting short enough.
Pressure washing

- Pressure wash the element immediately after de-moulding.
- Remove the membrane before pressure washing the surface.
- Pull the membrane off the element starting in the corners and working towards the middle. Pack the membrane into a separate recycling container.
- Use a pressure washer to wash off the unset concrete layer on the surface of the element. Do the washing normally but take note of the following issues:
  - Keep the age of maturity of the concrete at the washing time the same for elements that will be used in the same building/assignment in order to achieve a consistent end result.
  - The composition, ductility, temperature of the concrete, thickness and type of element, and the temperature of the building/mould all affect the time of washing. The correct timing for the washing is determined in the preliminary tests.
  - Washing patterned exposed fine aggregate finishes is more delicate work than washing a surface that is completely exposed with surface retarder, so we recommend using as few washers as possible. The person doing the washing should know what kind of pattern should be exposed so that he/she can use greater pressure on the second wash after checking the result of the first wash.
  - Special care should be used when washing the edges of the element as the strength of the concrete is normally lower there.
- Following the washing, quality control checks the element, performs the required finishing work and transfers it to the product warehouse after drying and curing.
5.3 Using the technology in a prefabrication plant (no vacuum table)

The graphic concrete process produces a fine exposed aggregate surface on a concrete element in more efficiently, cost-effectively and safer than traditional liquid surface retarders. A dry special retarder membrane is placed on the bottom of the mould and concrete is cast on the membrane. The actual pattern on the surface of the concrete results from the contrast between exposed and smooth concrete finish.

The production process for the elements is similar to that used for producing traditional exposed fine aggregate finishes.

Read all the material in the GCTechnologyFolder before using graphic concrete in production.

Preliminary tests and trial castings

- The plant has to perform preliminary tests and preparatory tasks prior to starting to use graphic concrete products (see: 1 Before using graphic concrete products).
- The preliminary tests include trial castings using various concrete recipes and membranes as well as learning how to use the membrane in production. This helps ensure quality and production efficiency.

Preparations

- Use the best possible mould surface under the membrane.
- Even the smallest irregularities in the mould surface (for example, marks left by a hammer) are imprinted on the concrete surface.
- Turn the mould heat off.
- Element production begins with cleaning the mould. Contaminants between the mould surface and the membrane or blisters in the mould surface will be visible in the concrete surface as a larger depression in the concrete surface.
- Level the mould surfaces carefully using a sanding machine and pestle.
- Use a vacuum cleaner to remove all loose dust and sand particles.
- Always remove all contaminants and sharp edges from the mould surface prior to spreading the membrane.
- Do not use mould oil on the surface.

Clean the mould surface with ultimate care. Keep the membrane clean and undamaged.
Spreading the membrane on the mould table

- Spread the membrane on a clean mould table and place it in the correct position. Please note that there may be crop marks and instructions printed on the membrane margin.
- Check the correctness of the pattern or image being printed on the membrane prior to continuing work. Do not use a defective or damaged membrane for producing a concrete product.
- If it is necessary to walk on the membrane, use shoe covers.
- Before setting the edges, check that the membrane is set tight and straight against the surface of the mould table. You can perform this procedure by using a soft brush and pulling the ends of the membrane to straighten it.
- Check that there are no contaminants left between the mould surface and the membrane.
- If necessary, remove the contaminants.

Crop marks and instructions may be printed on the membrane margin.

Place the membrane tight and straight against the mould table.
Setting the mould edges and building the mould

You may (A) set the mould edges on the membrane or (B) precut the membrane into the correct size and place the membrane sheet inside the mould.

Procedure A

- Set the edges of the mould on the membrane and lock them to the mould table.
- If necessary, cut the membrane under magnets.
- Set up the equipment for the mould in the right places and attach to the mould surface with magnets or by supporting them over the edges.
- Check the correct placement and dimensioning of the membrane before proceeding.
- Cut the membrane inside the mould edges with a sharp cutting knife. Cut a 1–2 mm reserve to make the membrane float freely on the table. This allows the air to come out between the table and the membrane. It also keeps the membrane from wrinkling as the membrane may freely straighten during the casting process.

Procedure B

- Precut the membrane into the correct size.
- Cut the membrane sheet 2-4 mm smaller in width and height than the element.
- Place the membrane sheet inside the mould.
- As the membrane sheet is smaller than the element, a 1–2 mm reserve/gap is left between the membrane and the mould edge.
- The membrane floats freely on the table. This allows the air to come out between the table and the membrane. It also keeps the membrane from wrinkling as the membrane may freely straighten during the casting process.
- Check the correct placement and dimensioning of the membrane before proceeding.

Set the mould edges on the membrane and then cut a 1-2 mm straightening reserve.
Precut the membrane into the correct size and place the membrane sheet inside the fixed mould.

It is important that the membrane floats freely on the table and that there is a 1-2 mm straightening reserve/gap next to the mould edges.
Reinforcing the element

- Reinforce the element normally, being careful not to damage the membrane.
- Place the spacers on the membrane.
- Lift the reinforcements onto the membrane and the spacers and tie them into place. Be careful not to damage the membrane during reinforcement.

Casting and compacting the element

- Begin casting by carefully pouring the concrete onto the mould from a short distance above the membrane surface. You can also pour the concrete via a board laid over the edges or on top of the reinforcements. Avoid pouring the concrete mass from too great a height because it may damage the membrane.
- Begin casting from the middle of the element.
- After starting the casting, pour the mass from the container into the mould from as low a height as possible on top of the already cast concrete face.
- Casting proceeds systematically from the middle towards the edges.
- At the same time, check that the membrane stays straight.
- Use external vibration to compact the element in the normal manner. Use sufficient compacting time but keep the time as short as possible.
- If using a poker vibrator to assist compacting, do not allow it to penetrate to the bottom of the mould.
- Keep the time between casting and compacting short enough to avoid spreading of the surface retarder and the pattern.
- Finish the cast surface in the normal manner.
Pressure washing

- Remove the element from the mould normally and transfer it to the finishing point. Pressure wash the element immediately after de-moulding.
- Remove the membrane before pressure washing the surface.
- Pull the membrane off the element starting in the corners and working towards the middle. Pack the membrane into a separate recycling container.
- Use a pressure washer to wash off the unset concrete layer on the surface of the element. Do the washing normally but take note of the following issues:
  - Keep the age of maturity of the concrete at the washing time the same for elements that will be used in the same building/assignment in order to achieve a consistent end result.
  - The composition, ductility, temperature of the concrete, thickness and type of element, and the temperature of the building/mould all affect the time of washing. The correct timing for the washing is determined in the preliminary tests.
  - Washing patterned exposed fine aggregate finishes is more delicate work than washing a surface that is completely exposed with surface retarder, so we recommend using as few washers as possible. The person doing the washing should know what kind of pattern should be exposed so that he/she can use greater pressure on the second wash after checking the result of the first wash.
  - Special care should be used when washing the edges of the element as the strength of the concrete is normally lower there.
  - Following the washing, quality control checks the element, performs the required finishing work and transfers it to the product warehouse after drying and curing.

High pressure wash the element immediately after de-moulding. Wash the edges carefully.
5.4 Summary of the production instructions

Carry out tests in a real production environment.

Thoroughly clean the mould table.

Spread the clean membrane on a carefully leveled and clean mould table. Make sure that the membrane is tight and straight against the mould table.

Pour the concrete carefully and as close to the table surface as possible. Keep the time between pouring and compacting short enough to avoid spreading of the surface retarder and the pattern. Wash with high pressure water immediately after de-moulding. Wash the edges and corners carefully.
6 Sealing graphic concrete surfaces

A graphic concrete surface can be sealed with different kinds of materials. However, sealing is by no means mandatory and in some instances, it is not recommended. By using sealers, it is possible to change both the aesthetic and the technical properties of the concrete surface.

Depending on the graphic concrete application, it is sometimes good to apply a sealer to protect against graffiti, bad weather conditions, heavy mechanical burden, and so on. For example, on floor or pavement slab surfaces there may be a need to protect the surface against mechanical stress or to improve the maintenance properties. The contrast of the pattern may become stronger by using appropriate sealing materials.

Anti-graffiti treatment

Sacrificial protection is the most suitable for use with graphic concrete. It is important to test how the treatment affects the color and the contrast of the pattern.

Improving mechanical strength

Depending on the intended purposes of the element with a graphic concrete finish, there may be a need to improve the durability of the concrete surface.

The durability and the "maintenance friendliness" of graphic concrete can be improved by using a purpose fit coating. A wide range of options can be used, from light impregnation to a 2 mm two component epoxy varnish.

In most instances, the adhesion between the graphic concrete surface and the sealer is strong enough to meet the highest requirements. Normally, no further steps are required to improve the adhesion of the sealer. Normally there is no need to improve adhesion.

Note: All sealers need to be thoroughly tested with new concrete recipes and application areas prior to commercial use. The responsibility of Graphic Concrete Ltd. is restricted to the products it sells.
7 Practical advice for successful casting

Several different factors affect the outcome of a graphic concrete surface, including the work performed by the prefabrication company, the design of the graphic concrete and how the membrane is produced. As all of these factors are related to each other, plans and decisions should be made with an understanding of the entire process and the envisioned visual outcome.

Three elements that affect the end result: the design, the membrane and the materials.

1. The design
   - The scale and the details of the pattern
   - The percentage of the exposed surface compared with the smooth surface
   - The choice of the cement, the aggregates and potentially, the pigments or oxides used.
   - Crop marks and other instructions printed in the membrane margin.

2. The graphic concrete membrane
   - The surface retarder used (GC-SK0030, GC-SK0100 or GC-SK0150)

3. The materials and the prefabrication process
   - The type of cement, aggregates and other raw materials
   - The equipment used for casting graphic concrete
   - The production process, the working methods, timing etc.

A high quality graphic concrete element fulfils the following requirements
   - The overall outlook of the facade or the wall is homogenous
   - The overall finished colour corresponds to the planned colour
   - The image contrast between the exposed and the smooth area is as planned
   - The line between the exposed and the smooth area is sharp
   - The surface is even and without any “banana effects” or small hollows
   - The pattern continues from one element to another as planned
An example of a successful wall – the entire wall and a close up shown.
Below you can find practical advice for producing a graphic concrete surface meeting the highest quality standards.

**Banana effect**

**Symptom**
- The concrete surface looks like the membrane has not been totally flat and there has been an air bubble between the membrane and the mould surface.

**Causes of the symptom**
- The membrane has not been completely flat and attached to the mould surface before the casting. Too much air has been left between the membrane and the mould surface.
- The membrane has straightened under the weight of the concrete and the edge of the membrane has hit the mould edge and folded.
- Casting has not started from the middle of the element. The air that had been stuck between the mould and the membrane could not get out but stayed in the middle forming an air bubble.
- Humidity has penetrated the membrane and deformed it.

**Solutions**
- Use a vacuum table.
- Press the membrane carefully against the mould table before casting.
- Pay attention to the storing conditions (a dry and a warm place).
- Do not cut the membrane until the same day as using it.
- In particular if no vacuum table is used:
  - Make the sheet of the membrane 2 to 4 mm smaller than the elements. This allows the membrane to straighten and the air to come out between the membrane and the mould surface.
  - Start casting from the middle of the element towards the edges.
Intended smooth areas of concrete are exposed (washed)

Symptom
- Aggregates are exposed also on the smooth areas (non retarded) of the concrete surface. The pattern clearly spreads and the line between the exposed and the smooth area is not sharp. Often this phenomenon is stronger on the edges and corners of the element.

Causes of the symptom
- Concrete has not been hard enough before the pressure washing and a thin layer of cement has been washed off.
- The surface retarder has been too strong for the concrete recipe.
- The retarded concrete mass has moved during the compacting process.

Solutions
- Increase the curing time of the concrete
- Decrease the compacting time, for example by making changes to the concrete recipe
- Use a weaker retarder
- Change the type of cement (lower alkali contents)
- Wash edges and corners with care and lower pressure
Concrete under the membrane

Symptom
• The surface of the concrete is not completely even next to the edge of the element. When lifting up the element small areas of concrete are visible on the mould side of the membrane.

Causes of the symptom
• During the casting process concrete mass has leaked under the membrane.

Solutions
• Use a vacuum table. As a result, you don’t cut the membrane and concrete mass can’t leak under the membrane.
• Press the membrane carefully against the mould table before casting.
• When spreading the concrete mass onto the membrane, make sure that concrete does not leak under the membrane.
• Spread the concrete mass from the middle of the element vertically towards the edges.
Pattern is not visible enough

Symptom
- The pattern does not appear clearly enough on the concrete

Causes of the symptom
- The exposed areas of the pattern are too small (a design issue).
- The size of the pattern is too small and too detailed (a design issue).
- The colour contrast between the cement and the aggregates is too small (a recipe issue).
- The exposure is not deep enough. As a result, the aggregates are not exposed. (A retarder strength, recipe and concrete production process issue).
- The water pressure is too low when washing the element (a concrete production process issue).
- Other unwanted phenomena on the concrete surface disturb the visibility of the pattern. These phenomena can include strong decarbonation and colour differences (a recipe and concrete production process issue).

Solutions
- Adjust the design by making the exposed areas larger and the pattern bigger and more robust.
- Adjust the recipe to create more colour contrast between the cement and the aggregates.
- Decrease the amount of pigments because many times they cause colour differences inside one element and between adjacent elements.
- Make other adjustments to the recipe in order to make the hardening of the concrete slower.
- Use the graphic concrete membrane with a stronger surface retarder.
- Diminish the time between casting and washing off the concrete surface.
- Use more pressure when washing the element.
- Decrease the decarbonation effect and make all elements homogeneous in colour.
Shadow - effect

Symptom
- A dark shadow area can be detected by the edges of the pattern.

Causes of the symptom
- The time between pouring the concrete on the membrane and compacting the concrete mass has been too long. The surface retarder has started working before compacting and the retarded concrete mass has moved to the intended smooth area.
- The concrete mass has moved during the compacting process.

Solutions
- Reduce the time between pouring the concrete mass and compacting.
- Make adjustments to the table vibration in order to keep the concrete mass from moving along the membrane surface during the compacting process.
- Make changes to the recipe, e.g. use cement with a lower alkali content (Na2Oeqv < 0,6%).
- Decrease the compacting time, e.g. by making changes to the recipe.
- Use a weaker surface retarder.
Small hollows on the concrete surface

Symptom
• Small hollows appear on the concrete surface. In particular, they are visible on the smooth areas of the concrete.

Causes of the symptom
• The mould surface was not clean enough before spreading the membrane on it.

Solutions
• Clean the mould surface very carefully with a vacuum cleaner
• Use shoe covers or otherwise protect the table surface when walking on it
• Show the employees the importance of cleaning the mould. The surface needs to be cleaner than with other casting technologies
• Use a vacuum table. A vacuum table doesn’t make the table surface any cleaner, but when the vacuum is on, all the small crumbs under the membrane become visible.

A strange totally exposed area on the element

Symptom
• A spot on the concrete surface is completely exposed.

Causes of the symptom
• The concrete mass has hit the membrane with force and the aggregates have scratched the retarder away.
• The problem occurs more easily when using self-compacting concrete as it flows much faster.

Solutions
• Pour the concrete mass onto the membrane with care.
• Pour the concrete mass close to the membrane surface.
• Pour the concrete mass first on a plate (e.g. plywood) to prevent it hitting the membrane too hard
Decarbonation (efflorescence) and inhomogeneous surface

Symptom
- The concrete surface looks dirty and the overall outlook is not homogeneous.

Causes of the symptom
- Decarbonation. Calcium has come out and disturbs the pattern.
- There have been changes in the concrete mixture between the elements.
- There have been changes in the production process of the concrete elements.
- Excessive amounts of strong colour pigment have been used.
- Producing a smooth, pigmented mould surface is very challenging, especially with dark colours.

Solutions
- Decrease the decarbonation effect. In order to avoid decarbonation it is essential to protect the element as long as possible (and have the same procedure with all the elements). Try to keep the elements indoors for approximately 3 days after casting.
- Emphasise quality assurance and keep the concrete mixtures and the process timings the same with all the elements.
- Decrease the amount of pigments. If pigments are used, increase the percentage of the exposed areas compared to the smooth areas. Strongly pigmented smooth areas are challenging.
- Use white cement instead of grey. White cement gives much better results with pigments compared to grey cement.
- Wash the facade with high pressure water and soap (no acid washing!).
How to make the cutting and the placing of the membrane easier

Symptom
- Sometimes it is hard to place the membrane in the correct position on the mould or to cut the membrane in the right places. The places for the mould sides and corners are particularly difficult to find if the image doesn’t have any surface retarder (ink) on the sides and corners.

Causes of the symptom
- The pattern/image doesn’t have any retarder (ink) on the sides and corners.
- No crop marks or other facilitating instructions have been printed on the membrane margin.
- Shop drawings have not been complete enough. The pattern/image placement on the concrete element has not been clearly instructed.

Solutions
- Discuss with the architect or designer and make sure that sufficient crop marks are printed on the membrane margin to make the work easier on the shop floor.
- Make sure that the shop drawings will be detailed enough to instruct the placement of the pattern.

Good element drawing and crop marks printed on the membrane makes image placing easier.
8 Order-delivery practices

In order to make all the processes smooth and to help ensure the highest quality outcome please provide us with all the following information.

Order information for all orders

1. Official project/order name

2. Product name (one of the following):
   • GCCollection™ > give the name of the pattern and the printing height (3200 mm).
   • GCPro™
   • GCArt&Design™
   • GCSmooth™

3. Strength of the surface retarder
   • GC-SK0030, GC-SK0100 or GC-SK0150

4. Total amount of products ordered
   • The amount in linear meters of membrane or pieces of images.
   • Please consider that the following factors affect the real amount of membrane needed:
     • The height and the shape of the elements being cast
     • The required pattern continuity from one element to the adjacent one
     • The pattern design compared to the facade design
     • Extra membrane needed for testing, training and waste

   Tip: Remember to include enough waste membrane in the order. Ordering a small amount of the same pattern afterwards will be more expensive.

5. Desired delivery time and delivery address with contact person details (full name, phone, email)

6. Special requirements
   • Special packaging instructions, post printing services e.g. cutting etc.
   • Crop marks and other instructions to be printed on the membrane margin

Further information needed for GCPro™ and GCArt&Design™

7. Final image file(s) ready for printing (see: GCDesignInstructions)

8. Printing instructions, i.e. how the image/pattern should be printed on the membrane

The order will be considered as definitive only once we have confirmed it in writing.
9 Pricing principles

Graphic concrete products

With regards to the design, you can choose from one of the following product categories:

- GCCollection™ (see: www.graphicconcrete.com)
- GCPro™
- GCArt&Design™
- GCSmooth™

Graphic concrete membrane is sold in the following units:

- linear meters, lm (GCCollection™ and some GCPro™ patterns)
- pieces, pcs (GCArt&Design™ and some GCPro™ patterns)
- rolls (GCSmooth™)

The unit price of the membrane depends mainly on two factors:

- The size of the repetitive pattern (report) or the image
- The total amount ordered

The most cost efficient choice is to use a repetitive pattern in high volumes. With regards to the design, there are three basic ways to make the use of graphic concrete more economical:

1. Use a repetitive pattern instead of a large unique image
2. The smaller the repetitive pattern (report), the more cost efficient it becomes
3. Using one repetitive pattern in high volumes decreases the unit price of our membrane

A price list is available for GCCollection™ patterns, GCSmooth™ and simple GCPro™ patterns. Please contact our local representative to order the price list. For more complicated projects, prices are calculated separately. Pricing for intricate custom designs are calculated on a project-by-project basis, and are also subjected to the determining factors listed above.
10 Sales and marketing support products & services

We also supply complementary products for testing and for your own sales and marketing purposes. The products are described below.

**GCSlabPackage**

Graphic concrete sample slabs and brochures

Languages: English, Swedish, Finnish

Contents

- Two graphic concrete sample slabs
- GCBrochure
- GCCollection™ brochure
- GCDesignInstructions
- GCReferenceBook

**GCTubes**

Graphic concrete sample membranes, casting instructions and brochures

Languages: English, Swedish, Finnish

Contents

- Graphic Concrete sample membranes
- GCBrochure
- GCCollection™ brochure
- Instructions for casting small sample slabs
- GCDataStick

**GCTechnologyFolder**

Information and instructions for prefabrication

Languages: English, Finnish, Swedish, Italian, French and German
GCDesignInstructions

Information and instructions for designers.

Languages: English, Swedish, Finnish, Italian and French

Contents
- General Instructions for Designers
- The Graphic Concrete Design process
- Preparing your Ready for printing file
- Examples
- Production Process

GCBrochure

Contains general information on graphic concrete.
Languages: English, Swedish, Finnish and Italian

GCReferenceBook

Features inspirational graphic concrete projects.
Languages: English

GCDataStick

Graphic Concrete information and instructions in a digital format.
General terms and conditions

These general terms and conditions enter into force on June 15th 2013 and are subject to any subsequent changes by Graphic Concrete Ltd.

General

These general terms and conditions of sale ("Conditions") shall apply between Graphic Concrete Ltd as seller (the "Seller") and its client as buyer (the "Buyer") in respect to the sale and delivery of Seller’s Products unless otherwise expressly agreed in writing with respect to all or part of the provisions contained herein.

These Conditions will override any different or additional terms or conditions contained or referred to in an order form or other document or correspondence from the Buyer, and no addition, alteration or substitution of these Conditions will bind the Seller or form part of any contract between the parties unless they are expressly accepted in writing by a person authorized to sign on Seller's behalf. Seller explicitly rejects the applicability of Buyer's (general or specific) purchasing terms and conditions or other similar Buyer’s terms and conditions.

In these Conditions the expression “Products” shall mean in particular special membrane manufactured by Seller enabling the manufacturing of graphic concrete elements but also any other products or services of the Seller.

Orders

The Buyer shall order Products by written purchase orders. All purchase orders will be accepted entirely at Seller's discretion. Any possible acceptance by Seller will take place by means of Seller's order confirmation (hereinafter "Order Confirmation").

Each order that is accepted by the Seller will, together with the relevant Order Confirmation and the Conditions, constitute an individual legally binding agreement between the Seller and the Buyer and such agreement will hereinafter be referred to in these Conditions as the “Agreement”.

Delivery terms and transfer of title and risk

If not otherwise agreed, the Products are delivered under the delivery term “Ex Works Jokioinen, Finland” (Incoterms 2010).

The delivery period and delivery date set forth in the Order Confirmation are only approximate and shall not be binding upon the Seller.

If not otherwise agreed, the Seller shall select the mode of transport and carrier.

Ownership and title to the Product shall not pass to Buyer until the Seller has received purchase price in full including all accrued default interest, charges and all other applicable costs and expenses.

Prices and payment terms

Except as expressly otherwise provided in Order Confirmation, Seller’s prices are exclusive of all sales tax, value-added tax, withholding or any other kind of applicable taxes, duties, levies or charges in any jurisdictions levied in relation of the Products or the delivery thereof.
If, after the date of Order Confirmation, the raw material prices or other production costs for the Products increase or should the purchase, production, transport or any other costs relating to the Products increase due to changes in the rates of exchange, or export or import duties, custom charges, taxes on export, import or delivery or similar duties or charges increase or should new duties, taxes and/or charges be introduced and implemented in respect of the Product, the Seller shall be entitled to revise the price accordingly.

Payment shall be made by the Buyer within fourteen (14) days following the date of Seller’s invoice by means of wire transfer to the bank account mentioned in the seller’s invoice. All payments shall be made without any set-offs, withholdings or deductions.

If the Buyer is delayed with any payment the Seller shall be entitled to default interest calculated from the due date until the date of actual payment at the rate interest of eleven (11) percent p.a.

Instructions

Buyer should carefully comply with all instructions given by Seller in respect of the Products. The instructions are also available from info@graphicconcrete.com.

In particular, it is emphasized that the membrane shall be stored in a dry, warm space protected from sunlight and that the Membrane should not be cut until just before the use of the Membrane. For the avoidance of doubt, the Seller shall not be held liable for any defect caused by non-compliance of instructions.

Warranty and seller’s liability

Warranty

Seller warrants that the Products are free from defects for a period of (a) one (1) year from the date of the delivery ("Warranty Period"). During the Warranty period Seller will at its discretion repair or replace the Products which proves to be defective in material and/or workmanship provided that the Buyer has duly complied with all the instructions in respect of the Products and defect was not caused by improper use (in whole or in part) of Product.

BUYER HAS AN OBLIGATION TO PROMPTLY INSPECT THE PRODUCTS AFTER THE DELIVERY AND BUYER SHALL REFRAIN FROM ANY USE OF DEFECTIVE PRODUCTS IN MANUFACTURING PROCESS.

Limitation of liability

Seller’s liability for any and all claims arising out of or in connection with the Products and the use thereof shall be limited to direct damages only. Seller’s sole obligation and the Buyer’s sole remedy are limited to the cost of repair or replacement of the defected Product and shall under no circumstances exceed the sales price of the defective Product supplied to Buyer.

Seller shall under no circumstances be liable to Buyer or any other party for any kind of incidental, indirect, consequential or punitive damage or loss, cost or expense, including without limitation, damage based upon lost goodwill, lost sales or profit, delay in delivery, work stoppage, production failure, impairment of other goods or based on any other cause, and whether arising out of or in connection with breach of warranty, breach of contract, misrepresentation, negligence or otherwise. Neither is Seller liable for any damage, costs or liabilities caused by the use of defective Product or improper handling thereof or use of the Product for any other purpose than in which the Product is intended.

Warranty given hereunder is addressed to the Buyer only and is not given and may not be assigned to any third party, including but not limited to Buyer’s customer. However, in case if the Buyer is distributor of Seller’s Products, then the warranty is also given to the end user of the Product i.e. distributor’s direct customer.
Any complaint or claim regarding the Products shall be sent to the Seller without delay, but in any case within fourteen (14) days of detecting the defect and during the Warranty Period. All claims must be made in written form and it shall include sufficient evidence of the defected Product e.g. samples (suitably packaged and carriage paid) and photographs thereof.

**Intellectual property rights**

Subject to any right of third party(ies) all samples, specifications, drawings, models or other technical documents and other know-how of the Products or related to the production of the Products provided by the Seller to the Buyer are and shall at all times remain the sole and exclusive property of the Seller. Buyer shall not have any right to use, copy, assign such documents or know-how or disclose such documents or know-how or any other related technical or commercial information to any third party without the prior written consent of the Seller.

The Buyer represents and warrants that all the drawings and models to be used in Products provided by the Buyer to the Seller do not infringe any intellectual property right of any third party and that there does not exist other restrictions that would prohibit the use of such drawings and models in the Products. Should the Buyer become aware of any such potential infringement or restriction, the Buyer shall notify the Seller forthwith. Notwithstanding the above the Buyer shall always indemnify and hold the Seller harmless from any cost, loss or damage arising out of any claim, demand, suit or proceedings against the Seller claiming that Products infringes upon any intellectual property right of any third party or other restriction mentioned above.

**Force majeure**

Seller shall not be liable in any way for any damage, loss, cost or expense arising out of or in connection with any delay, restriction, interference or failure in performing any obligation towards the Buyer caused by any circumstance beyond its reasonable control, including, without limitation, laws and regulations, administrative measures, natural disasters, war, terrorism, riot, sabotage, accident, epidemic, strike, lockout, slowdown, labour disturbances, currency restrictions, export or import bans, difficulty in obtaining necessary labour or raw materials, lack of or failure of transportation, breakdown of plant or essential machinery, emergency repair or maintenance, breakdown or shortage of utilities, delay in delivery or defects in goods supplied by suppliers or subcontractors.

**Applicable law and disputes**

These Conditions and all matters connected to the delivery are governed by and shall be construed in accordance with the laws of Finland excluding its conflict of laws principles. The application of UN convention on Contracts for the International sale of Goods is excluded.

All disputes arising out of or in connection with the Agreement or delivery of the Products shall be settled in the district court of Helsinki (Helsingin käräjäoikeus), Finland as a court of first instance. This clause is for the benefit of the Seller only and Seller shall, at its own discretion, have the right to initiate legal proceedings against the Buyer in any other court with jurisdiction.
Declaration of Graphic Concrete products

We hereby certify that our products (membrane) conforms to the Essential Requirements of the Packaging and Packaging Waste Directive 94/62/EC and do not contain harmful substances. The concentration level of heavy metals present in our material complies with the demand of the Directive (Article 11), i.e. that the sum of the concentration levels of lead, cadmium, mercury and hexavalent chromium is below 100 ppm.

According to the REACH norm (the European Community Regulation of Registration, Evaluation, Authorisation and Restriction of Chemical substances) a Safety Data Sheet (SDS) is not needed with Graphic Concrete products (EY N:o 1907/2006).

Graphic Concrete membrane can safely be used following the instructions given by the supplier.

Graphic Concrete Ltd