MINIMUM REQUIREMENTS FOR THE INSTALLATION AND OPERATION OF CONCRETE PRODUCTS

1. Concrete products from Betono mozaika SIA are typical products, but their selection and installation in the pavement requires specific knowledge, skills and tools. In order to ensure that concrete products maintain the performance declared by us as the manufacturer and are suitable for their intended use throughout the warranty period, the selection of concrete products and the installation of the pavement should be carried out by a company(-ies) / professionals specialized in this field, who are familiar with the requirements set out in this document and the special requirements for the installation of the products for each type (if any), as published on the website www.betonomozaika.lv for the product(s) to be purchased.
2. If the Buyer decides to resell the concrete products purchased from Betono mozaika SIA to a third party, the **following Minimum Requirements must be transferred to such third party together with the resold products.**

STORAGE AND TRANSPORT

3. The packaging system used by the manufacturer to pack the concrete products is designed to ensure that the surface of the products is scratched as little as possible during transport and handling. However, scratches on the surface of the products may occur during transport and handling and the manufacturer shall not be held liable for any scratches up to a depth of 0,5 mm (scratches on the surface of the product up to a depth of 0,5 mm shall not be considered as defects of the products, *see p.8.1 of the Warranty Terms and Conditions*.)
4. We suggest avoiding additional handling and transportation of products, as this can lead to the products being damaged or scratched more than usual.
5. Concrete products can be transported by all types of transport, ensuring the safe transportation of the products. The products must be stored securely in bundles or stacks, in accordance with workplace safety regulations.
6. After delivery/arrival of the products, we recommend that you use the products for paving without a delay. Prolonged storage of the products is likely to result in the appearance or increase of lime stains on the surface of the products.

MINIMUM REQUIREMENTS FOR THE INSTALLATION OF CONCRETE PRODUCTS

DESIGN OF THE PAVEMENT AS A STRUCTURE

7. For simple engineering structures of Group I, the preparation of a building design is not mandatory. In all other cases, the installation of the pavement structure layers and soil shall be carried out in compliance with the structural design and the requirements for the installation of the pavement structure layers and soil in the normative documents.
8. The paving work and its supervision should be carried out by a legal or natural person who is qualified of carrying out the construction work, i.e., who has the right to carry out the work/qualified to carry out such work.

PAVEMENT CONSTRUCTION

Base

9. The layers of the pavement structure shall be constructed using either loose mineral mixtures or bonded mixtures. The bonded layer of the pavement structure shall be water-permeable. Concrete products laid in a pavement where water-impermeable bonded mixtures of building materials (mortars for the underlayer and/or joint filling) are used for the installation of the underlayer and/or joint filling are not covered by the guarantee of Betono mozaika SIA/they are not guaranteed to comply with the declared performance (*see page 11.5 of the Warranty Terms and Conditions*).
10. The declared performance of concrete products laid in a pavement is influenced by the deformation moduli of the load-bearing layers of the pavement structure and the water permeability coefficient:

    10.1. The magnitude of the deformation modulus depends not only on the properties of the base on which the structural layers of the pavement are installed, but also on the materials of the structural layers of the pavement, the class of the future pavement structure, and the design characteristics of the pavement as a structure. For this reason, the size of the deformation modulus must be selected in accordance with the with normative acts and standards for the design and installation of pavement structures;

    10.2. the water permeability (filtration capacity) of the layers of the pavement structure and of the soils on which the structure is installed, as measured by the value of the water permeability coefficient k, shall be: $k \geq 1.0 \times 10^{-5}$ m/s.
11. Concrete products, as a surface finishing material, are an integral part of the pavement structure. As regards the pavement structure characteristics, it should be noted that:

    11.1. the strength/stability of the pavement is 90% determined by the base (its installation) and only 10% by the concrete product itself (the declared performance of that product) as a surface finishing material. For example, if the pavement structure is too weak due to inadequate base, it may develop depressions and ruts, resulting not only in the deterioration of the vehicles driving on the pavement, but also in damage to the surface finishing material (cracks in the surface of the concrete products laid in the pavement, or even detachment of parts of the product);

    11.2. If the pavement structure has a water permeability coefficient lower than the required one, the surface of the pavement made of concrete products will start to crack and detach in winter due to atmospheric impact.

Concrete paving edges (curbs, edgings)

12. The purpose of concrete pavement edging is to ensure that concrete products are fixed in the pavement. Their proper installation limits the displacement of the concrete products placed in the pavement, which can lead to damage to the products.
13. Concrete of not less than Class C 12/15 shall be placed on the installed base at the curb locations. The concrete base shall be installed by placing the concrete in two layers, each layer being individually tamped or vibrated. The edging shall be placed on the compacted concrete base before the concrete has begun to bond. To ensure stability, a haunching of minimum thickness of 10 cm shall be provided at the rear of the product. The recommended width of the non-paved area above the haunching shall not be less than 15 cm.
14. Fluctuations in ambient temperature and operational loads affect the movement of the edging. To avoid edge cracks in the concrete edgings, they must not be pressed together, i.e., they must be installed with a gap of 3 to 5 mm. These gaps shall be left unfilled or filled with elastic material if required.

Concrete water gutters

15. Concrete of not less than Class C 12/15 shall be placed on the installed base at the location of the gutters. The recommended concrete thickness is 15 - 20 cm. The concrete base shall be compacted before laying. The gutters shall be laid on the concrete base before the concrete has begun to bond. During the laying process, joints shall be formed with a minimum width of 8 mm and a maximum width of 12 mm. The joints shall be filled with bonded fine-grained filling. Expansion joints shall be installed at intervals of at least 12 metres, and a bituminous sealant for exterior applications shall be used to fill such joints.

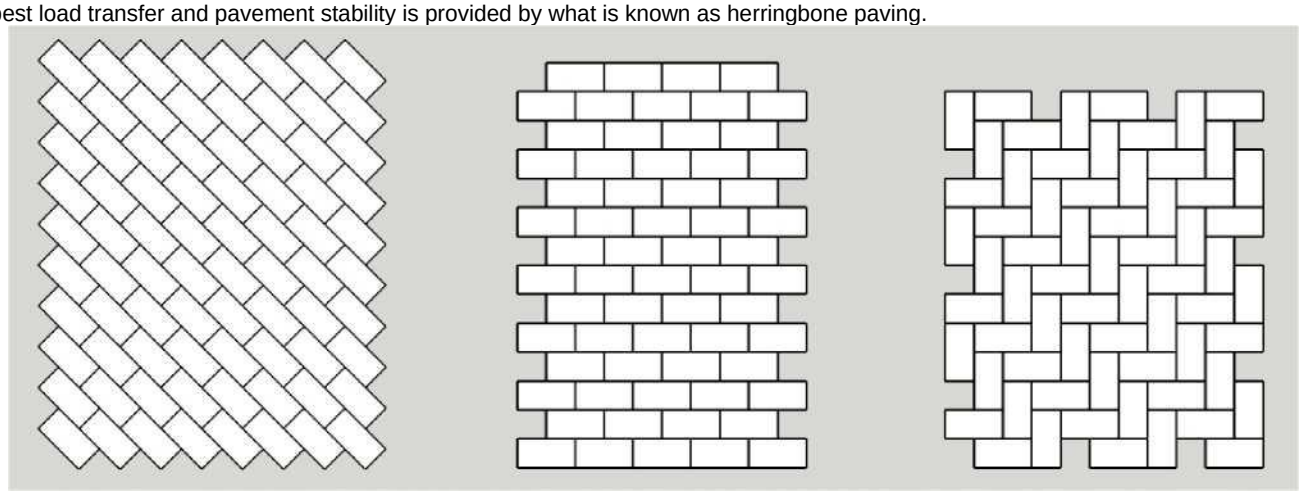
Concrete columns

16. Concrete of not less than Class C 12/15 shall be placed on the installed base at the locations of the columns. The recommended concrete thickness is 10 - 15 cm. The concrete base shall be compacted before laying. The columns shall be placed on the concrete base before the

concrete has begun to bond. Once the row of columns has been formed, haunching is installed on both sides. The haunching shall be made of a layer of concrete at least 10 cm thick and 10 cm wide. Once the concrete has hardened, it is possible to install a layer of vegetation on both sides of the column. In the case of installation of stair steps, it is recommended that the haunching is raised to the level of the step.

Concrete paving (pavers and slabs)

17. A sub-layer is installed on top of the bearing layer of the installed base. Due to the possible variations in the thickness of the concrete paving products as allowed in the legislation, we recommend that the sub-layer is compacted together with the laid concrete products. This ensures the uniformity of the concrete pavement.
18. The thickness of the sub-layer should be chosen to be approximately 1 cm higher (depending on its the material) than the thickness of the final structure as specified in the pavement design. The thickness and material of the sub-layer shall be selected:
    18.1. the thickness of the sub-layer in the compacted condition must be between 3 cm and 5 cm. The sub-layer shall be of high quality, i.e., 0/4, 0/5, 0/8 loose mineral mixtures complying with the requirements of the 'Technical Specifications for Road Pavements, Slabs and Other Materials - TRA Pavers 14" for the composition of the sub-layer material;
    18.2. when the thickness of the compacted sub-layer exceeds 4 cm and the thickness of the product is 120 mm or more, a high quality 0/11 non-bonded mineral mixture complying with the requirements for the composition of the underlayer material as laid down in the "Technical Requirements for Road Pavements, Slabs and Other Materials - TRA Pavers 14" shall be used for the sub-layer.
19. The products shall be laid in a forward direction from the paved area to avoid stepping on the levelled paving sub-layer. Cutting at the edges of the pavement can be avoided by proper spacing of the concrete paving edges. A rope may be used to ensure the straightness of the row of products. If no concrete edging is to be installed at the edges of the pavement, then a concrete support should be used to edge the paved area preventing displacement of the laid slabs towards the edge.
20. It is important to ensure the stability of the pavement when installing it. Failure to do so results in product displacements, which lead to product breakages and product part detachments. The stability of the pavement is influenced not only by the concrete edging installed, but also by the shape of the products and the chosen laying pattern.
21. Inadequate pavement loads are one of the causes of damage to the surfaces of concrete products laid in pavements. It is therefore essential to carefully plan and calculate future pavement loads.
22. The paving is carried out according to the chosen paving pattern. The choice of paving pattern must consider the future use of the pavement:
    22.1. In areas of paving where motorised traffic is not expected, there are no restrictions on the choice of product shape and laying pattern;
    22.2. In paving areas where the movement of light and/or temporary auxiliary traffic is foreseen, rectangular products (e.g., *see products named Prizma 6, Prizma 6B, Prizma 7, Prizma 8, Prizma 10 Set, Nostal 6 Plus*) shall not be laid with the long side of the product oriented in the direction of the movement of traffic. For rectangular products, a laying pattern that provides sufficient resistance to torsion (tilting) may be used, and we recommend that you choose a laying pattern that is either transverse, diagonal or herringbone (*see images below*);
    22.3. In areas of the pavement where heavy traffic and extreme loads are foreseen, interlocking pads (*such as the products Tavr 8, Tavr 10*) or a paving pattern with a high resistance to torsion (tilting) must be used. The recommended paving pattern is herringbone paving;
    22.4. A diagonal in respect to traffic direction pattern allows better load transfer from one product to another than a transverse pattern. The best load transfer and pavement stability is provided by what is known as herringbone paving.



Laying pattern "diagonally" *Laying pattern "transversely"* *Laying pattern "herringbone"*

23. When laying concrete products, it is necessary to form joints between the products. When products are laid without joints, the edges of the products begin to crack due to the applied load.
24. Protrusions (compensators) on the edges of products are not intended to ensure the correct width of the joint. Since the purpose of the joint is to transfer the load applied to the product to another product next to it, the width of the joint must be chosen according to the type and thickness of the product:
    24.1. for paving pads and slabs the thickness of which is under 120 mm, the width of the joint shall be between 3 mm and 5 mm;
    24.2. for paving pads 120 or more mm thick, the width of the joint shall be between 5 mm and 8 mm;
    24.3. for slabs the thickness of which is 120 mm or more, the width of the joint shall be between 5 mm and 10 mm.
25. The joints shall be filled with mineral filler up to the top of the product and swept. Incomplete filling of the joints does not guarantee the stability of the pavement and may lead to edge splits. For the filling of the joints, non-bonded mineral mixtures complying with the requirements of Section III of the document 'Rules for the Installation of Pavement Structures of Pavers and Slabs for Roadways', JT Pavers 14" are suitable. The use of uncertified screenings or other uncertified fillings for joint filling is prohibited, as they may cause visual changes to the concrete products, including staining.
26. Depending on the width of the formed joint, mineral mixtures of the following fractions can be used: 0/2, 0/4, 0/5, 0/8. Water-permeable joint materials can also be used, which not only prevent the growth of grass but also increase the stability of the pavement. The installation of such joints shall be carried out in accordance with the instructions of the manufacturer of the joint material.
27. The area paved with concrete products shall be vibrated with a vibratory plate, which protects the products during the process against the common scratches, cracks or partial separations of the product. The vibration shall start from the edge of the pavement and move towards the centre, only being sure that the concrete pavement is completely clean and dry. This is necessary to ensure because during vibration, solid materials trapped under the vibratory plate will scratch the surface to be vibrated and may cause a split off from the surface of the concrete product.
28. Please note that before using any vibratory plate, it is essential to consult the manufacturer or seller of the vibratory plate in question as to

the suitability of the vibratory plate for the particular application on the area paved with concrete products.

29. If the manufacturer or seller of the vibrating plate indicates that it is suitable for use with conventional vibrating plates and/or vibrating plates with polyurethane rollers, we recommend that vibrating plates with polyurethane rollers are preferred. This type of roller is superior to conventional vibratory plates as it (i) better protects the concrete product from damage during compaction, (ii) does not displace the vibrating products, (iii) tends to damage the edges of the concrete product less. Vibratory plates with polyurethane rollers are particularly recommended for use on non-bevelled products, slabs. Please note that the suitability of a vibratory plate for a particular application must be checked with the manufacturer or seller of the vibratory plate.
30. Areas where the joints are not filled or are not completely filled must not be vibrated, as the stability of the pavement will not be ensured, which could result in edge cracking of the concrete products.
31. Differences in the height of the paving cannot be compensated for by simply vibrating concrete products by force with a vibratory plate, as this can also lead to part of the product split off.
32. After vibrating, the joints between the products are refilled with mineral filling and such ready paving may be put in use at once.

MINIMUM REQUIREMENTS FOR THE USE OF CONCRETE PRODUCTS

33. The durability of concrete products as a surface finishing material is influenced not only by the stability and strength of the installed base, but also by the future pavement operation conditions. If the user of concrete products does not ensure proper operating conditions, the manufacturer does not guarantee the conformity of the product with its declared performance characteristics.
34. During the operation of a pavement made of concrete products, it is necessary to:

    34.1. ensure safe operation of concrete products. For this reason, activities that damage the structure of the product are prohibited during operation (e.g., no traffic of vehicles with metal tracks, no use of the pavement with loads higher than those intended by the design or the concrete products, no storage of sharp-edged objects on the pavement, no storage of objects by impact on the pavement). Failure to comply with these instructions will result in mechanical damage to the structure of the products (larger than normal scratches on the surface of the products, and possible chipping of the products). The manufacturer does not guarantee the conformity of such (damaged) products with the declared performance of the product;

    34.2. ensure proper filling of the joints between concrete products with jointing material. Incomplete joint filling does not ensure the stability of the pavement and may lead to edge chipping. The manufacturer does not guarantee the conformity of such (damaged) products with the declared performance of the product;

    34.3. continuously remove dirt on the surface of the concrete paving, as:

        34.3.1. during operation, solid dirt under the applied external load may damage the structure of the product, i.e., scratch, dislodge or otherwise mechanically damage the product more than usual. The manufacturer does not guarantee the conformity of such (damaged) products with the declared performance of the product;

        34.3.2. concrete products are absorbent. The storage/storage of construction or other materials on the surface of a concrete pavement is prohibited, as dirt or staining or lubricating substances on the surface of the pavement may mechanically adhere to or become absorbed into the products and leave visible stains on the surface. For this reason, especially if dirt or staining or lubricating substances are not removed from the pavement for a prolonged period of time (e.g., on a pavement installed using concrete products, storage of screenings), the products may be visually altered, including staining. In order to prevent staining or have less intense staining of the products, we recommend the use of impregnates (please contact Betono Mozaika SIA sales offices for information on the impregnant and its use) or the use of TCP technology products (*see the description of TCP technology products at* www.betonomozaika.lv *)*

    34.4. Only certified concrete cleaning products may be used to clean concrete pavements, following the cleaning product manufacturer's instructions. When removing dirt or snow accumulation on the pavement, it is important not to damage the surface of the concrete products laid in the pavement.
35. During operation, rust stains may occur due to contaminants or other iron-containing agents on the pavement, e.g., soil saturated with iron oxide (in which water carries iron oxide to the pavement surface), water running on the pavement from metallic elements, weed and insect killers containing iron sulphate, etc. When weeding or spraying insect repellents on lawns, we recommend not to do so in areas close to pavements or on a windy day, as the wind will disperse the iron sulphate-containing product widely in the air and the risk of it getting on the pavement, even if it is not used close to the pavement, is high. The removal of rust stains from concrete pavements is difficult and often impossible. Cleaning agents for the removal of such stains are available on the market, but they are often based on hydrochloric acid and usually have only a minimal effect. Higher concentrations of acid cleaners may even darken existing rust stains, so we recommend testing the cleaner on a single product and evaluating the result before cleaning the entire area (please note that Betono Mozaika SIA is not responsible for the testing of the cleaning agent on the concrete product, the effectiveness of the cleaning agents and/or any adverse effects on concrete products).
36. Ice often forms on the surface of pavements in winter. To improve the adhesion of slippery pavements, we suggest using natural stone products: sand (only suitable for footpaths), crushed stone or a mixture of sand and crushed stone (only crushed stone or a mixture of sand and crushed stone is suitable for traffic areas). We recommend removing snow from the pavement before spreading these products. The most effective application of natural stone products is the day before the pavement freezes. When using natural stone products, it is important to ensure that (i) the particles of the product used are sufficiently heavy and are not blown away by the wind, and (ii) the size of the particles does not cause injury to persons, vehicles or other property (in areas where natural stone products are sprinkled on the surface, we recommend that the speed of vehicles be limited and that a safety distance between vehicles be increased). In particular, we recommend that you test products with particles of up to 5 mm at your own risk. If you do not achieve the desired result with products made of particles up to 5 mm, you can try products made of larger particles. When snow and ice have melted, the adhesion-enhancing materials used in the pavement must be removed (*see p. 34.3 of these Minimum Requirements*).
37. In cases where it is necessary to remove the accumulated ice layer, only technical ice-melting salt may be used, taking into account the information contained in this paragraph below, at your own risk and after you have assessed the possible damage to the pavement surface. **Please note that the use of ice-melting salt may cause corrosion of the concrete** (corrosion is a process of destruction of the concrete structure, which reduces the manufacturer's declared performance of the product and therefore the durability of the product) **and discolouration of the product**. According to an independent study carried out by the KTU SMKTC (for *a description and the results, see the document 'Freezing-Heating Resistance Study' available on the website* www.betonomozaika.lv*), the* exposure of concrete paving stones to a salt solution results in a certain amount of chipping of the surface of the concrete pavers. Although, thanks to the advanced production of Betono Mozaika SIA, the value of the chipping of the samples obtained in the study is many times lower than the minimum limit tolerated by the standard for concrete products, we are not able to assess the intensity of the possible corrosive effect of the salts in a specific case. Therefore, in the unavoidable case of the need to use a salt for ice that has formed on the pavement melting, we recommend that you use a type of salt that is less aggressive to the concrete and that you test it initially on a part of the pavement (to make sure that you are satisfied with the result).

FINAL PROVISIONS

38. Specific installation and/or operational requirements may apply to certain types of products (e.g., openwork products). Such requirements are set out in a separate document, which is always available at www.betonomozaika.lv In cases where specific installation and/or performance requirements are laid down for individual product types, the installation and performance requirements for concrete products set out in this document (Minimum Requirements for the Installation and Use of Concrete Products) shall apply to the extent that they do not conflict with the specific requirements, i.e., to the extent that the specific requirements do not provide otherwise than in this document.
39. This document is also available at www.betonomozaika.lv .