

RECOMMENDATIONS AND MINIMUM REQUIREMENTS FOR LAYING CERAMIC PAVING ELEMENTS

GENERAL PROVISIONS

1. The ceramic paving elements manufactured by LODE SIA are standard products. Choosing and laying them requires knowledge, skills and tools. In order to ensure that the ceramic paving elements maintain the performance characteristics declared by the manufacturer LODE SIA, and are used correctly for their intended purpose, we recommend that the selection of ceramic paving elements and the laying of the pavement be carried out by specialised companies or professionals who are familiar with the requirements set out in this document, which are available on the manufacturer's website www.lode.lv.

2. If the purchaser resells the purchased ceramic paving elements to third parties, the purchaser is obliged to deliver these Recommendations and Minimum Requirements for the Laying of Clinker Paving Stones together with the ceramic paving elements to be resold to its third-party purchasers.

SELECTION OF THE APPROPRIATE TYPE OF CERAMIC PAVING ELEMENTS

3. The choice of paving materials should take into account the anticipated loads and other operational characteristics of the site. The right choice of material will determine both the lifespan and the performance of the pavement, but equally important is the correct use and care of the material.

4. The thickness of the paving elements must be chosen based on the expected load:

Paving element thickness	Intended use
40/47 mm	pedestrian paths, terraces, and courtyard areas not intended for vehicles
52 mm	low-intensity car traffic (e.g., private driveways, car parks)
60/62/65 mm	car traffic and limited heavy vehicle traffic
70 mm and over	medium-intensity traffic
80 mm and over	high-intensity traffic, streets and open areas, and areas with cargo vehicle traffic

5. Incorrectly choosing the thickness of the paving stone can lead to crumbling, cracks, displacement of the paving stones, and their early deterioration.

STORAGE AND TRANSPORTATION

6. For the packaging of ceramic paving elements, the manufacturer uses a packaging technology that minimises scratches on the surface of the products during transport or stacking. Scratches not exceeding 0.5 mm in depth may occur on the surface of ceramic paving elements during transport or stacking. They are not considered a defect of the ceramic paving elements according to clause 3.1 of the Warranty Provisions for Ceramic Paving Elements, available on the manufacturer's website www.lode.lv.

7. We recommend avoiding unnecessary handling or transport of ceramic paving elements, as this may lead to exceeding the permissible size of surface scratches and increase the risk of chipping pieces off the ceramic paving elements.

8. Ceramic paving elements may be transported by any type of vehicle that ensures their safe transport. Products must be stored in securely stacked packages or stacks, observing workplace safety rules.

MINIMUM REQUIREMENTS FOR THE LAYING OF CERAMIC PAVING ELEMENTS, CONSTRUCTION PLANNING DOCUMENTS

9. The laying of the ceramic paving elements and the preparation of the sub-base shall be carried out in accordance with the construction planning documents. If the preparation of such documents is not required by the relevant regulatory enactments, the laying of ceramic paving elements (including sub-base preparation) shall be carried out in accordance with the requirements of regulatory enactments and standards, manufacturer's regulations, etc., to ensure proper and correct sub-base preparation, the selection and laying of ceramic paving elements, and the operation of the laid ceramic paving elements.
10. The preparation of the sub-base and the laying of the ceramic paving elements and the supervision of these works shall be carried out by a natural or legal person with the appropriate qualifications.

PAVEMENT STRUCTURE

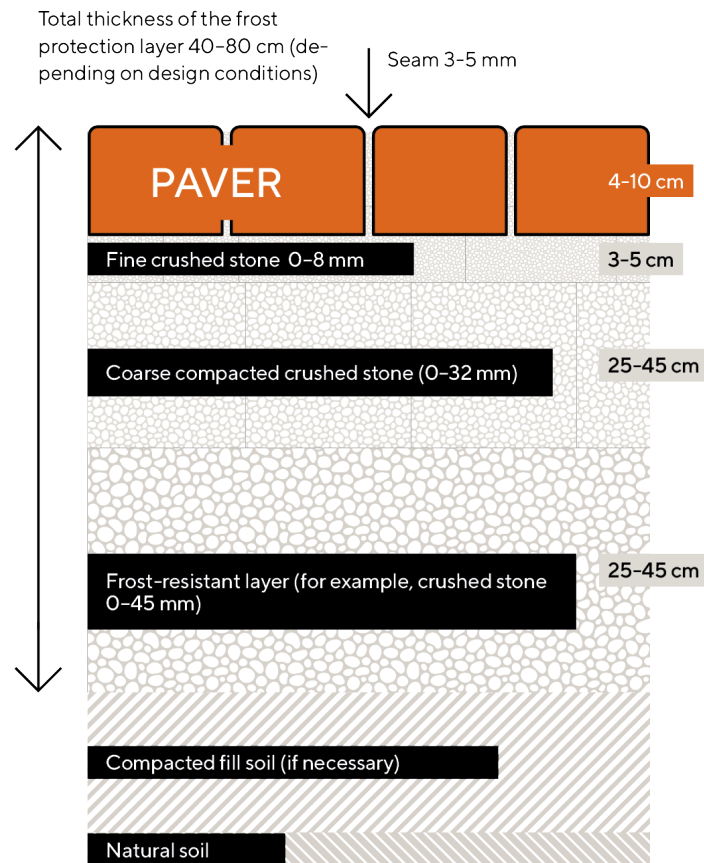
Requirements for the sub-base

11. The pavement construction layers shall be constructed using unbound aggregate mixtures (without binders) or bound mixtures (with binders, e.g., cement). The structural layer of the bound pavement shall be waterproof. For ceramic paving elements laid in pavements using waterproof bonded mortars (mortars for sub-layer and (or) joint fillers), LODE SIA does not provide a guarantee, nor does it guarantee the conformity of these products with the declared performance characteristics (see clause 5.5 of the Warranty Provisions for Ceramic Paving Elements, available on the manufacturer's website www.lode.lv).
12. The declared performance of ceramic paving elements in pavements is influenced by the deformation moduli and the permeability coefficient of the load-bearing layers of the pavement structure:
 - 12.1. the size of deformation modulus depends on the properties of the sub-base on which the pavement layers are installed, and also on the materials of the pavement layers, the design classes of the intended pavement, and the construction characteristics of the pavement. The size of the deformation modulus should be chosen in accordance with the regulations and standards for the design and installation of pavement structures (the deformation modulus of a soil is a physical-mechanical parameter that describes the ability of the soil to resist deformation (compression) under an external load);
 - 12.2. the permeability (seepage property) of the layers of the pavement structure and the soil on which the structure is installed, i.e., the value of the permeability coefficient k , shall be: $k \geq 1.0 \times 10^{-5}$ m/s.
13. Ceramic paving elements as surface finishing material are part of the pavement structure. With regard to the structural properties of the pavement, it is important to know that:
 - 13.1. the strength/stability of the pavement is 90% determined by the sub-base (its laying) and only 10% by the ceramic paving elements themselves as a surface finishing material (declared performance of the ceramic paving elements). For example, if the pavement structure is not strong enough due to an improperly constructed sub-base, it can develop sinkholes and gouges. The use of such pavements damages not only the vehicles travelling on them, but also the surface finishing material (paving elements are displaced, joint filling material settles, cracks form in the surface of the ceramic paving elements, parts of the product chip off);
 - 13.2. if the permeability of the pavement structure is lower than required, the ceramic pavement may start to crack and split due to weathering and climatic conditions.

Installation of the pavement sub-base

14. After grading and adequate preparation of the ground, the base course of the pavement shall be laid. The choice of the structure and thickness of the supporting layers depends on the expected loads and, in particular, on the expected traffic volumes on the finished pavement, as well as on the climatic conditions. The supporting layer must be waterproof, stable, resistant to anticipated loads, and frost-resistant (to prevent deformation due to frost).

15. For this purpose, the supporting layer shall be approximately 25 cm thick, made of crushed stone or crushed-gravel mix (fraction 0–32 mm or 0–45 mm). This option applies to the creation of footpaths, cycle paths, garden paths, terraces, courtyards, etc. Where paving is intended for streets and roads with heavy vehicular traffic, the load-bearing layer shall be designed and installed in accordance with the relevant standards and regulations, with a frost-resistant layer under the load-bearing layer where appropriate.



16. If the sub-base is made up of several layers, it is preferable that one of them, at least 15 cm thick, is free of fines to limit the capillary rise of the groundwater level.

17. The crushed stone or crushed stone-gravel mixture shall be laid and compacted in layers, in several passes, until the specified layer thickness and density are achieved. Even when compacted, the bearing layer must be impermeable and have a slope (gradient) of approximately 2.5%.

Ceramic paving curbs

18. For ceramic paving, the ceramic paving elements themselves (either vertically or on their sides), metal and concrete edging, natural stone material, or other, may be used as curbs.

19. The purpose of ceramic paving curbs is to ensure that the ceramic paving elements are fixed in the pavement. Their correct installation limits the movement of ceramic paving elements. Distortion must be limited to prevent damage to the ceramic paving elements.

20. Concrete of at least Class C 12/15 shall be laid on the installed sub-base at the curb locations. The concrete sub-base shall be laid by placing the concrete in two layers, with each layer being separately vibrated or tamped. The curbs shall be placed on the compacted base before the concrete starts to set. For stability, a support of at least 10 cm shall be provided at the rear of the curb. Where no paving is laid over the support, a minimum width of 15 cm is recommended.

21. Fluctuations in ambient temperature and exposure to operational loads affect the movement of the curbs. To avoid splitting of the edges of the ceramic paving curbs, they must be placed with a minimum gap of 3–5 mm. Gaps shall be left unfilled or filled with flexible material as necessary.

Ceramic paving water gutters

22. In ceramic paving, storm water gutters can be made either of the ceramic paving elements themselves; of special ceramic elements; or of gutter elements made of concrete or natural stone materials. Concrete of at least Class C 12/15 shall be laid on the installed sub-base at the gutter locations. The recommended concrete thickness is 15–20 cm. The sub-base must be compacted before the concrete is laid. The gutters shall be placed on the concrete sub-base before the concrete starts to set. During laying, joints are formed with a minimum width of 8 mm and a maximum width of 12 mm. The joints shall be filled with a fine-grained bonded filler. Deformation joints shall be installed at intervals of not more than 12 metres and shall be filled with a bituminous sealant for outdoor use.

Laying of the levelling layer (or sub-layer)

23. Guidance before installing the sub-layer and pavement:

23.1. do not install the sub-layer and/or pavement during heavy rain or snow;

23.2. do not use frozen sub-layer material for installing the sub-layer;

23.3. do not install the pavement on a frozen sub-layer;

23.4. do not install more sub-layer area than can be covered by the ceramic paving elements on the same day.

24. It is recommended to keep the sub-layer materials outside covered with a film to reduce moisture loss and to avoid saturation with rainwater.

25. The levelling layer shall be 3–5 cm thick and shall be made of high-quality, certified and 0/4, 0/5, 0/8 mm fraction unbound aggregate mixtures (stone chippings, gravel or crushed stone mix) appropriate to the composition of the sub-layer.

26. The thickness of the levelling layer in the compacted state should be 30–50 mm. It is better to use a crushed stone mix containing fewer fine particles, as this promotes the faster drainage of water from the pavement surface.

27. The sub-layer shall be installed on a bearing layer with irregularities not exceeding 10 mm, measured transversely and longitudinally with a 3 m long ruler. If more than 10 mm is found, the irregularities must be corrected. The use of sub-layer material to correct the flatness is not allowed as it will cause the pavement to sink.

28. The thickness of the lower layer should be chosen to be approximately 1 cm greater (depending on the material of the lower layer) than the intended final thickness of the structure.

29. The levelling layer material must be sufficiently hard and well compacted, and it is not desirable to add soluble substances (e.g., salt, lime, etc.), as these can cause salting on the surface of the pavement in the form of white spots.

30. The levelling layer material shall be applied to the required thickness and levelled using guides and a batten, after which the guide shall be removed, and the depressions left by the guide shall be filled. Instead of using guides, the adjacent paving (if any) can be used to flatten the layer, in which case cut-outs of the appropriate size must be made at the ends of the batten.

31. The levelling layer, like the bearing layer, shall be levelled with a 2.5% slope (fall) to ensure the same slope (fall) for the finished pavement.

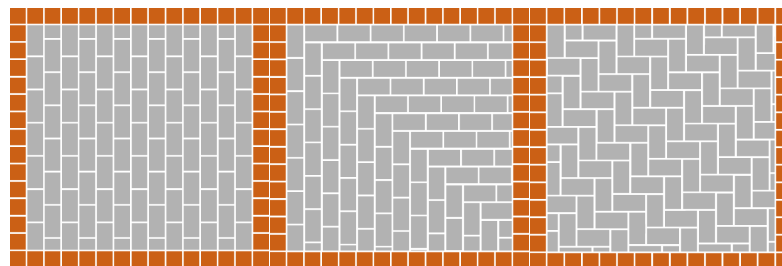
32. The sub-layer may also be installed in one of the following ways before the products are laid on the sub-layer:

32.1. fill the required amount of sub-layer material to achieve the required compacted layer thickness; compact with a vibratory plate, level to the required height, and scratch the sub-layer surface to a thickness of 10 mm;

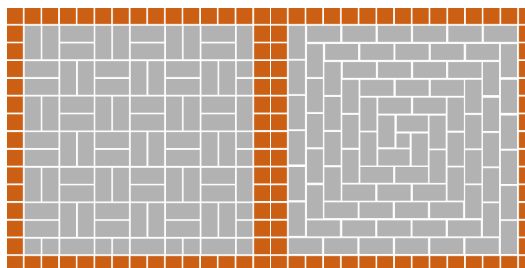
32.2. spread the sub-layer material, ensuring that the layer thickness is not less than the nominal compacted layer thickness, and compact it with a vibratory plate; in addition, spread 10–15 mm of sub-layer material, level to the intended height.

Ceramic paving (paving elements)

33. The delivered clinker paving elements shall be visually and volumetrically inspected before laying. Any disagreements on delivery quantities, quality, or appearance, shall be resolved before paving.
34. Pavement elements with visible defects shall not be laid in the pavement.
35. It is recommended to mix the paving from several pallets at the same time when laying the paving to give a more uniform appearance to the finished paving surface.
36. When paving stones and slabs are laid, it is important to ensure their stability. If this is not ensured, natural shearing occurs, causing the products to split and the parts to delaminate. The stability of ceramic paving elements is influenced by the shape of the paving curbs, the products chosen, and the laying pattern.
37. Improper loads are one of the causes of surface deterioration of laid ceramic paving elements. It is, therefore, very important to carefully plan and calculate the expected loads on the ceramic paving elements.
38. The laying shall be carried out in accordance with the chosen laying pattern. The choice of paving pattern should take the purpose for which the paving is to be used into account:
 - 38.1. in areas where motorised traffic is not expected, there are no restrictions on the choice of shape and laying pattern of the product (ceramic paving elements);
 - 38.2. in areas where the temporary movement of light vehicles or rescue vehicles is foreseen, rectangular shaped products shall not be laid with the longest edge of the product in the direction of vehicular movement. For laying rectangular products, a decking pattern that provides sufficient resistance to shearing (rotation) can be used, so we recommend a transverse, diagonal, or herringbone decking pattern (see figure);
 - 38.3. where heavy vehicle movements and special loads are foreseen, a pavement pattern that provides high resistance to shearing (rotation) should be used. The preferred paving pattern to be used is “herringbone”;
 - 38.4. a pattern that is diagonal to the driving direction allows for better load transfer from one product to another compared to a cross pattern. The best load transfer and pavement stability is provided by paving in a “herringbone” pattern:



“Herringbone”



39. The ceramic paving elements shall be laid starting from one side, moving forward along the laid products to avoid stepping on the smoothed sub-layer of the paving. Cutting into the edges of the pavement can be avoided by choosing the correct spacing between the edges of the ceramic paving elements. A string can be used to ensure the straightness of the product line. Where curbs are not

provided at the edges of the pavement, a concrete abutment shall be used to restrict the movement of the laid pavement in the direction of the edges.

40. The ceramic paving elements are laid in a staggered manner, in strips of 4–5 rows (as far as the hand can reach in one go). As soon as the next 4–5 rows have been laid, the joints shall be immediately filled with the jointing material provided so that the paving elements are fixed. Once the joints have been filled, the pavement can be stepped on to lay the next rows.

41. It is recommended to lay the paving elements on the prepared levelling layer in stages, in approximately 2 m wide strips. To maintain straight joint lines and joint widths, it is recommended that directional cords are set every 1–1.5 metres (or more frequently if necessary) when paving to guide the pavement.

42. When laying ceramic paving elements, it is mandatory to create joints 3–5 mm wide between them. When products are laid without seams, the edges of the products may be subject to splitting under load.

43. Protrusions (or expansion joints/distancers) may be provided on the side edges of certain types of ceramic paving elements to facilitate jointing. These expansion joints/distancers ensure a minimum joint width, but for an accurate paving pattern and straight lines, a directional cord must be used and may require adjustment of the joint width.

44. Temporary spacers (e.g., plastic sheets 3–4 mm thick, cut to the appropriate dimensions) may be used, if necessary, to ensure the required joint width, and shall be inserted between the paving elements during laying and carefully removed from the joints just before filling.

45. The joints in the paving shall be filled with aggregate up to the top edge of the paving elements and brushed. The brushing direction should be at an angle of approximately 45 degrees to the edges of the paving elements to allow the material to better fill the joints. Incomplete filling of joints does not ensure the stability of the pavement, which can lead to chipping of the edges and corners of the paving elements. Unbound aggregate mixtures are suitable for filling joints. The use of non-certified or unsuitable fillers to fill joints is prohibited, as they may not only cause mechanical damage to the products, but also visual changes to the ceramic paving elements, including the formation of spots.

46. Aggregate mixtures of the following fraction sizes may be used, depending on the width of the joint formed: 0/2, 0/4, 0/5 mm.

47. The most recommended option is to use a combination of 2 fraction materials to fill the joints: – the initial filling and topping up of the joints after vibration is done with the 0/5 mm fraction material, followed by further rinsing with water of the 0/2 mm material.

48. Waterproof jointing materials can also be used, which not only prevents grass growth but also increases the stability of the pavement. The formation of such joints shall be carried out in accordance with the instructions of the manufacturer of the joint material.

49. The area covered with ceramic paving products shall be vibrated with a vibrating plate having a centrifugal force not exceeding 12 kN and fitted with a lining of rubber (neoprene or other flexible material), thereby protecting the products from scratching, splitting or delaminating during the process. Vibration starts from the edge of the pavement, working towards the middle, making sure the pavement is completely clean and dry. During vibration, solid particles under the vibrating plate can scratch the surface to be vibrated or even break off part of the surface of the ceramic paving elements.

50. Before using any vibratory plate, the manufacturer or seller of the vibratory plate must be consulted on the suitability of the vibratory plate for tamping specific ceramic paving elements.

51. Products with unfilled or partially filled joints must not be vibrated, as this will not ensure the stability of the pavement and may result in the ceramic paving elements shifting out of place and the edges splitting.

52. If at the end of the work, there remains a sub-layer with unlaidd ceramic paving or with ceramic paving that has been laid but not compacted, cover all such areas with a film to protect them from rain. This must be done to prevent the sub-layer material from becoming saturated with precipitation.

53. Height differences in the pavement must not be levelled simply by force using a vibratory plate, as this can cause the edges of the product to split.

54. Pavement elements should not be stepped on or walked on when laid and not compacted, as, unless the joints are at least simply filled with jointing material, the pavement elements can very easily move out of place, deforming the pavement pattern created.
55. After vibration, the joints between the products shall be refilled with mineral filler. After filling the joints and brushing the filler, it is recommended to additionally apply and flush a finer fraction (0/2 mm) of filler into the joints with water until it no longer settles in the joints. This ensures that the filler compacts better in the seams.
56. After the surface has been vibrated and the joints finally filled, the pavement shall be allowed to settle and stabilise for at least 3 days before being put into service.

SAWING OF CERAMIC PAVING ELEMENTS

57. If necessary, clinker paving elements can be sawn with a saw for stone materials or an angle grinder (with a suitable diamond cutting wheel).

These provisions are published at www.lode.lv and may be updated/supplemented without notice.