



INSTALLATION INSTRUCTION TTE® PAVE

 **HÜBNER-LEE**

THE TTE® SYSTEM



The innovative TTE® element distributes the pressure of the forces acting on the surface, thereby significantly reducing the demands placed on the load-bearing capacity of the underlying surface. This allows the permeability of the underlying surface of soil to be retained and the thickness of the traffic-carrying surface to be reduced. The eco-friendly TTE®-building concept is tested and is based primarily on the FGSV¹⁾, FLL²⁾ and DWA³⁾ guidelines.

This unsealed TTE® PAVE represents a long-lasting, permeable surface covering, which possesses a high proportion of open joints and integrated storage cavities. Rainwater is temporarily stored by the underlying drainage trench base layer and seeps away gradually. TTE® PAVE thereby creates a highly efficient and near-natural solution for decentralised rain water management.

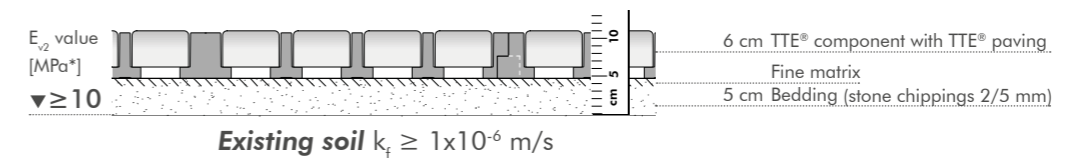
If nothing to the contrary has been defined in the plans and tender, the requirements and specifications of the TTE® construction method, taking into account the relevant regulations and standards, are to be observed in order to ensure proper functioning.

*) MPa = MN/m²
 1) German Road and Transport Research Association
 2) German Landscape Development and Landscape Design Research Society
 3) German Association for Water, Wastewater and Waste

TTE® CONSTRUCTION METHODS ACCORDING TO LOAD

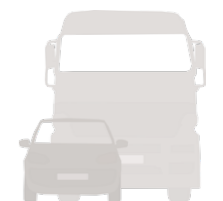
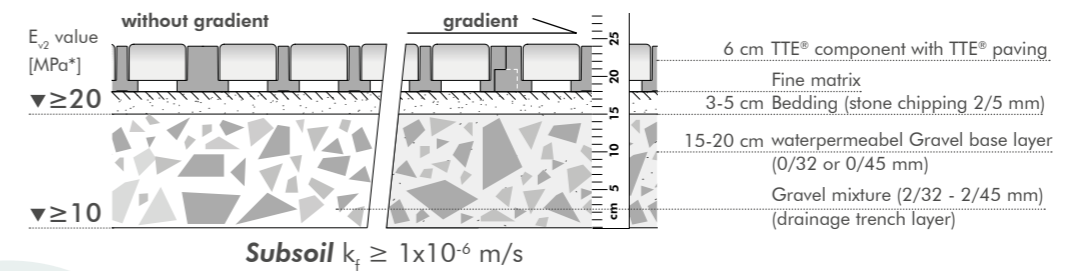
TTE® PAVE 1

For people and passenger car traffic up to a total weight of 3.5 t



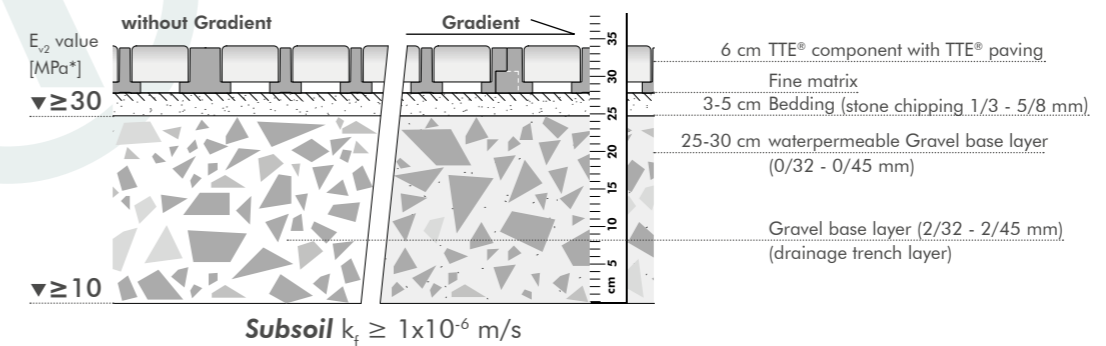
TTE® PAVE 2

For passenger car and occasional heavy traffic – up to RStO 01 building class V/VI or RStO 12 load class 0.3



TTE® PAVE 3

For heavy traffic up to 40 t – up to RStO 01 building class III / IV or RStO 12 load class 1.8



*) MPa = MN/m²

PACKAGING / PALLETISING

	TTE® components	TTE® paving stones
Pallet size	L x W x H 123 x 85 x 200 cm	L x W x H 92 x 92 x 80 cm
Pallet weight	approx. 800 kg	approx. 900 kg
Packaging unit per pallet	90 pc. (\triangleq 28.80 m ²)	1.440 pc. (\triangleq 14.4 m ² laid TTE® surface)
max. quantity delivered per truck	864 m ² (= 30 Paletten)	388.8 m ² (= 27 Paletten)
Fine matrix (separating mesh / installation aid)		24 g/m ² , width of roll 3.20 m

Half TTE® pallets: For very uneven and steeply inclined land we recommend requesting half pallets for the safe transportation of TTE® elements.

NOTES ON COMPACTION AND SEEPAGE

- Excessive compaction of the superstructure and grain splitting must be avoided
- Binding agents for improving the ground must not be used
- Take the weather conditions and soil humidity into consideration to prevent the soil structure from being disturbed
- Subsoil water permeability $k_f \geq 1 \times 10^{-6}$ m/s (otherwise additional drainage option)
- Superstructure water permeability $k_f \geq 5 \times 10^{-5}$ m/s
- Distance from the surface to the average highest groundwater level ≥ 1 m
- No contamination or contact with water-polluting substances in the seepage area
- Installation in water conservation areas and areas with high levels of pollution only in agreement with the relevant water authority

	Rough estimation	Proof
Assessing the load-bearing capacity	DIN 18035-4 traffic test	Load plate pressure test in acc. with DIN 18134
	Field test	Laboratory test
Permeability test	TP Gestein-StB (German Technical Test Regulations for Aggregates in Road Construction) part 8.3.2 rapid test	DIN 18130-1 or TP Gestein-StB
		FLL Recommendation for Tree Planting - part 2 (with medium steel test cylinder)

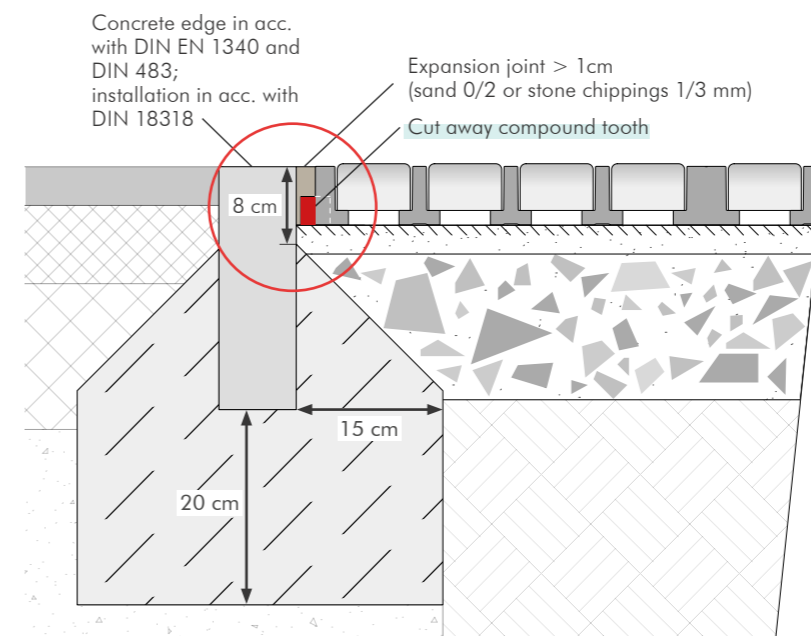
¹⁾ MPa = MN/m²

FOUNDATION SOIL

- If necessary, remove topsoils including planted land cover and ground true to profile according to layer thickness and connection heights
- Prepare the substructure in accordance with the TTE® building method requirements and ZTV E-StB (Supplementary Technical Contractual Requirements and Guidelines for Road Construction Earthworks), E_{v2} -value ≥ 10 MPa*

	TTE® construction method PAVE 1	TTE® construction method PAVE 2	TTE® construction method PAVE 3
Removal layer	approx. 10 cm	25 cm (F ₁ soils) 30 cm (F ₂ /F ₃ soils)	35 cm (F ₁ soils) 40 cm (F ₂ /F ₃ soils)

EDGING



Edging:

- Circumferential edging around TTE® surface
- For the in-line bond, in the case of purely fire brigade access roads, lateral edging can be dispensed with.
- TTE® GREEN and TTE® PAVE superstructures should be separated by a low kerb.
- Larger areas should be subdivided by additional curbs to improve the protection against displacement.

Avoid slab cutting

Surface dimensions = grid dimension 40.15 cm x X rows + 2 x expansion joint (each ≥ 1.5 cm) + 2 x joint to the edging, determine distances by laying trial rows.

We recommend that you determine the exact „pitch“ by laying out the boards before setting the shelves. For this purpose, order the goods to the construction site in good time.

¹⁾ MPa = MN/m²

BASE LAYER

- Pressure- and frost-resistant 0/32 to 0/45 mm aggregates in accordance with TL Gestein-StB (German Technical Test Regulations for Aggregates in Road Construction) and TL SoB-StB (German Technical Test Regulations for Building Layers without Binding Agents), fine particle content $\leq 0.063 \text{ mm} \leq 3 \text{ M.-%}$ (UF3)
- Use of arge-pored 2/32 to 2/45 mm building materials is permitted for a drainage trench base layer with increased water retention capability (areas without gradients)
- Install a gravel base layer in accordance with the TTE® building method and the TL SoB-StB and dynamically compact

	F ₁ soils	F ₁ /F ₃ soils	E _{v2} load-bearing capability	E _{v2} /E _{v1} ratio
TTE® construction method 2	15 cm gravel base layer	20 cm gravel base layer	$\geq 20 \text{ MPa}^*$	$< 2,0$
TTE® construction method 3	25 cm gravel base layer	30 cm gravel base layer	$\geq 30 \text{ MPa}^*$	$< 2,0$

BEDDING

- Compression-resistant and frost-resistant aggregates according to TL Gestein-StB and MVV4) (filter-stable to the base layer)
- Bedding of coarse-pored chippings (1/3, 2/4, 2/5, 2/8, 4/8, 5/8 mm) with a layer thickness of 3-5 cm to be drawn off flat

TTE® SYSTEM

1. Lay the fine matrix (separating mesh) on to bedding at the same time as the laying process, overlap approx. 20 cm
2. Join TTE® elements tightly together in alignment, without joints. Close small joints. (Consider type of bracing.)
3. Insert TTE® paving stones parallel to the laying of the slabs in TTE® elements.
4. Fill the construction joint between the kerb and the covering with sand 0/2 mm or chippings 1/3 mm
5. Vibrate the completely laid surface with a medium-heavy vibrating plate.
→ setting approx. 1.5 to 2 cm
6. Sprinkle the finished surface with 1/3 mm chippings at a rate of 1 l/m².

Installation rate: approx. 5-7 m²/person/hour

LAYING NOTES

- Areas of TTE® paving must not be sanded off. When sprinkling with stone chippings, the specified quantity of 1 l/m² (one 10 l bucket per 10m²) must not be exceeded, otherwise the infiltration capacity may be limited. The grit serves as a spacer in the slab joints against displacement and fixes the TTE® paving stones to reduce noise.
- For efficient installation, insert TTE® paving blocks directly at the installation site from the pallet into TTE® grids. Use a hand pallet truck to move in regularly.
- Lay a mixture of TTE® elements and TTE® paving stones from several pallets whenever possible

¹ MPa = MN/m² ⁴) Guideline on Permeable Traffic Areas



Laying of the TTE® elements on the fine matrix (installation aid).



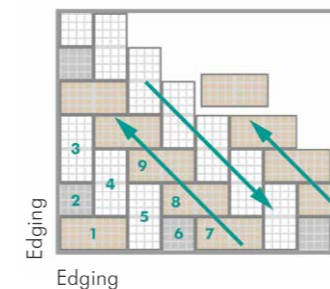
Ensure tight installation and regular tapping to prevent later forming of gaps.



For a more efficient procedure, the TTE® elements can also be laid pre-filled as TTE® directPAVE. Mechanical installation is also possible in this way.

TYPES OF BONDS

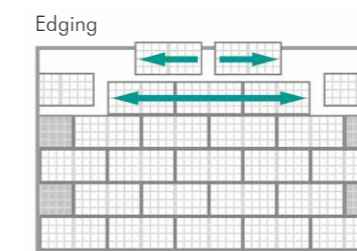
HERRINGBONE BOND STRETCHER BOND



Edging

Broad surface load
(e.g. car park, courtyard and storage areas)

- Diagonal laying in alternating rows
- Circumferential edging required

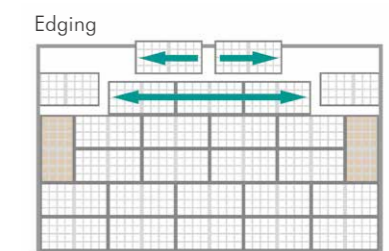


Edging

Linear load
(e.g. fire brigade access roads, driveways and roads)

- Lay transversely to the direction of travel
- For pure fire brigade access roads, a lateral edging can be dispensed with.

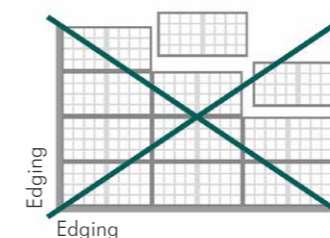
OFFSET BLOCK BOND



Edging

Light load

- Lay transversely to the direction of travel
- No intersecting of edging slabs
- Suitable for mechanical laying

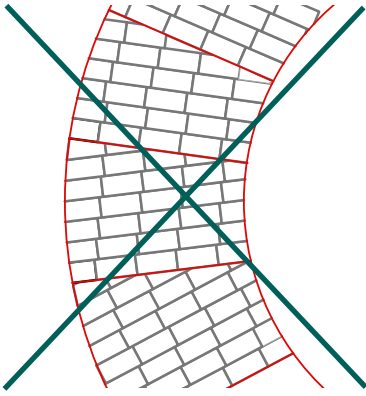


Edging

NO CROSS JOINT LINKS!

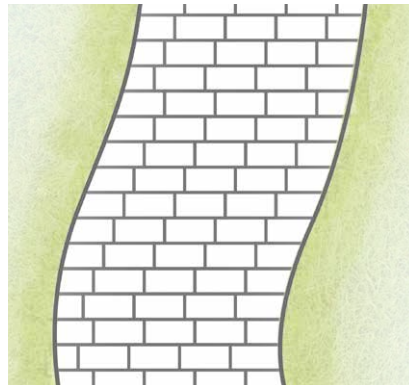
- Do not lay TTE® in a cross-joint bond, as this does not absorb shear forces well.
- This makes the surface more susceptible to the formation of unwanted joints

CHANGE OF DIRECTIONS



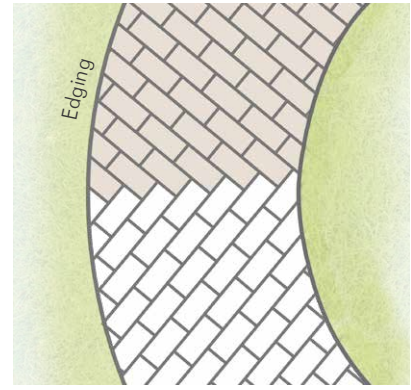
Avoid cuts

- Avoid cuts within the area as far as possible
→ loss of the bond
- By the loss of the bond the area becomes inherently unstable



Soft bends

- Create a slight change of direction by offsetting (overlapping by at least 2 cavities)

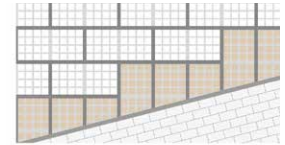
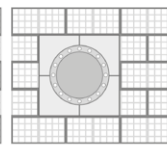
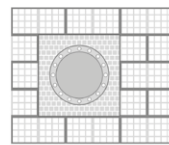


Sharp bends

- Rotation of bond by 90°

CUTS AND INTEGRATION

- Create cut edges in unfilled state
- Table / hand-held circular saw with HM Widia wood saw blade (jigsaw for recesses and tight radii)
- Edge slabs / half slabs by halving the elements



Edging on round installation by means of small paving stones in an unbound design or paving sets

Lay final rows lengthwise, if slab width is < 2 cavities at point of integration