TTE® PAVING Installation Guide

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 FGSV[1)], FLL[2)] and DWA[3)] guidelines.

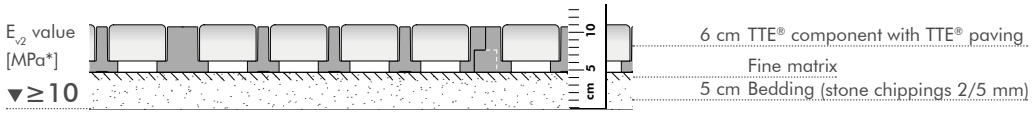
This unsealed TTE® paving represents a long-lasting, permeable surface covering, which possesses a high proportion of open joints and integrated storage cavities. Rainwater is temporarily stored by the underlying drainage trench base layer and seeps away gradually. TTE® paving thereby creates a highly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

It nothing to the contrary has been defined in the plans and tender (taking into account the relevant regulations and standards) the requirements and specification of the TTE® construction method must be observed in order to ensure proper functioning. Please also refer to the planning assistance.

TTE® Construction Methods According to Load

TTE® Paving 1

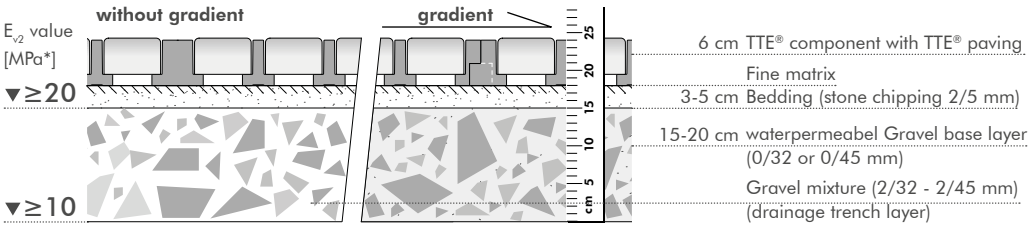
for people and passenger car traffic up to a total weight of 3.5 t



Existing soil $k_f \geq 1x10^{-6}$ m/s

TTE® Paving 2

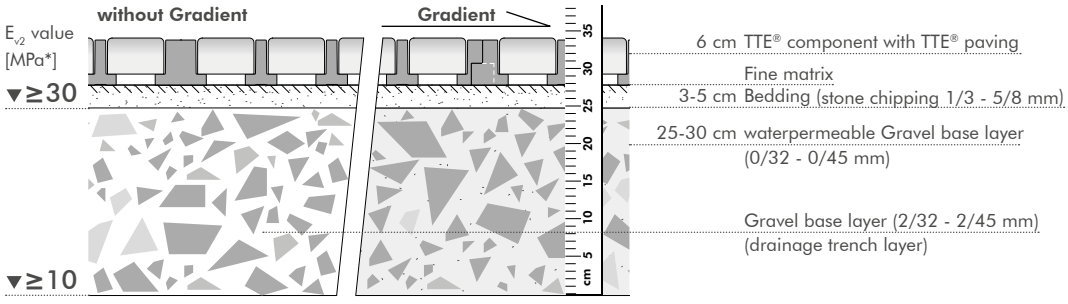
for passenger car and occasional heavy traffic – up to RStO 01 building class V/VI or RStO 12 load class 0.3



Subsoil $k_f \geq 1x10^{-6}$ m/s

TTE® Paving 3

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



Subsoil $k_f \geq 1x10^{-6}$ m/s

*) 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

Packaging / Palletising

- Delivery time: usually 3-7 working days

	TTE® Components	TTE® Paving Stones
Pallet size	L x W x H 123 x 85 x 200 cm	L x W x H 100 x 110 x 80 cm
Pallet weight	approx. 800 kg	approx. 960 kg
Packaging unit per pallet	90 pieces (≙ 28.80 m²)	1,560 pieces (≙ 15.6 m² laid TTE® surface)
max. quantity delivered per truck	864 m² (= 30 pallets)	390 m² (=25 pallets)
Fine matrix (separating mesh / installation aid)		24 g/m², 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
- Use of light tracked vehicles on subsoils and top-soils with a low load-bearing capacity
- 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

Layer	Recommended equipment for compaction
Foundation soil	Static with light roller
Mineral base layer	Dynamic e.g. with light to medium-weight plate compactor

Do not significantly exceed the requirements for compaction and load-bearing capacity, in order to avoid affecting the seepage capacity of the structure. Cohesive soils: **E_{v2} value ≤ 45 MPa***

	Rough estimation	Proof
Assessing the load-bearing capacity	DIN 18035-4 traffic test	Load plate pressure test in accordance 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)

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® Paving Building Method 1	TTE® Paving Building Method 2	TTE® Paving Building Method 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)

*) MPa = MN/m²

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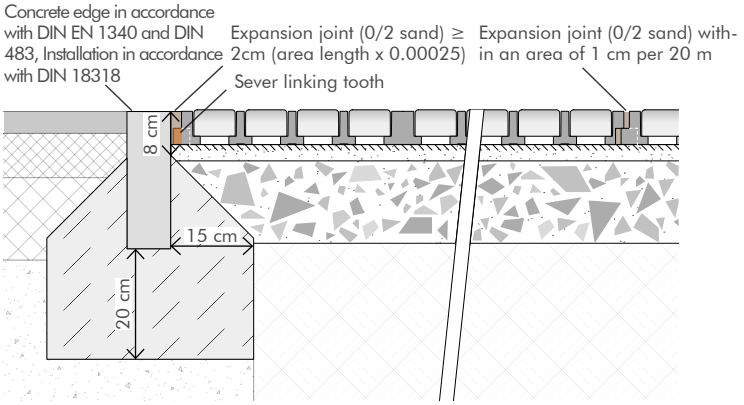
Edging

Edging is required:

- usually at the beginning/end of the laying process, parallel to the direction of installation (see bonding techniques)
- at transition points to connecting surfaces and areas which will be driven over
- in areas which will be placed under stress by shear and thrust forces (e.g. sharp bends,



Avoid slab cutting

Surface dimensions = grid dimension 40.15 cm x X rows + 2 x expansion joint (each ≥ 2 cm). Determine the spacing by laying test rows.

Expansion joints

Expansion joints between edging and TTE® (e.g. paved courtyard) each 0.00025 x area length (minimum joint 2 cm), expansion joints within the TTE® area (e.g. road starting from 100 m in length) 1 cm per 20 m

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 < 0.063 mm ≤ 3 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_2/F_3 soils	E_{v2} load-bearing capability	E_{v2}/E_{v1} relationship
TTE® building method 2	15 cm gravel base layer	20 cm gravel base layer	≥ 20 MPa*	< 2.0
TTE® building method 3	25 cm gravel base layer	30 cm gravel base layer	≥ 30 MPa*	< 2.0

Bedding

- 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 MVV (filter stability for the base layer)

TTE® System

1. Lay the fine matrix (separating mesh) on to the bedding at the same time as the laying process, overlap approx. 20 cm
2. Place spacers (e.g. battens) for expansion joints on the edging / installations
3. Insert TTE® paving into TTE® elements and place plates together without joints (take type of bond into consideration)
4. Fill expansion joints with washed 0/2 mm sand
5. Compact the fully laid surface with a medium-weight plate compactor with apron **=> setting approx. 2 cm**

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

Filling with TTE® paving and laying TTE® elements (80x40 cm format, filled with approx. 28 kg/piece)

*) MPa = MN/m² [4]Guideline on Permeable Traffic Areas

Laying Notes

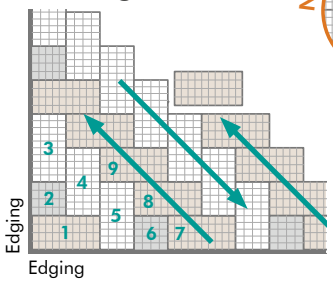
- **Areas of TTE® paving must not be sanded off**
- **As a general rule, lay transverse to the direction of travel**
- **Gather together palleted TTE® elements and TTE® paving slabs for filling in pairs and regularly move up to the installation site**
- **Lay a mixture of TTE® elements and TTE® paving stones from several pallets whenever possible**

Insertion of the paving stones in the TTE® element

Laying of the filled TTE® elements in twos

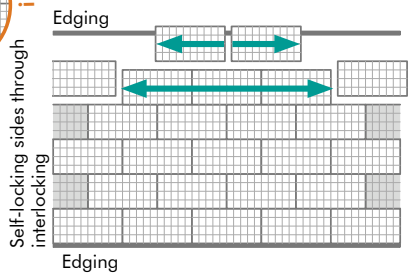
Types of bond

Herringbone bond



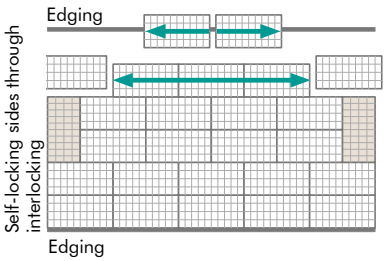
- **broad surface load** (e.g. events areas)
- Diagonal laying in alternating rows
- Circumferential edging required

Stretcher bond



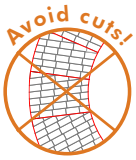
- **linear load** (z.B. roads)
- Lay transversely to the direction of travel
- Laying of multiple rows simultaneously is possible
- Edging usually only required parallel to the direction of installation

Offset block bond



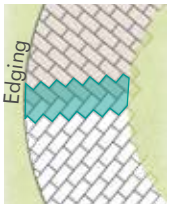
- **light load** (e.g. car parking areas)
- Lay transversely to the direction of travel
- No cutting of edge slabs
- Laying of multiple rows simultaneously is possible
- Edging usually only required parallel to the direction of installation (beginning/end of laying)

change of direc-



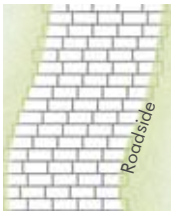
- Avoid cuts within the area as far as possible (loss of the bond)
- Cuts in edge area not usually required

sharp bends



- Rotation of bond by 90°
- Edging on one side if exposed to heavy loads
- Fix half slabs in place if necessary

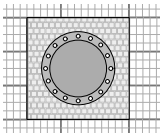
soft bends



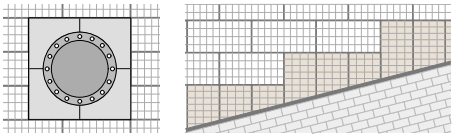
- Create a slight change of direction by offsetting (overlapping by at least 2 cavities)
- Protruding edges at naturally connecting areas e.g. grass-covered

Cuts and Integration

- Cut edges in filled condition with an angle grinder and cutting wheel for concrete
- Create cut edges in unfilled state with a table / hand-held circular saw with HM Widia wood saw blade (jigsaw for recesses)
- 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 connecting rows lengthways if slab width is < 2 cavities at point of integration

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