

# TTE® GREEN 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 has proven itself over the past 20 years, is tested and is based primarily on the FGSV<sup>1)</sup>, FLL<sup>2)</sup> and DWA<sup>3)</sup> guidelines.

The robust TTE® Green grid bridge directly absorbs shear and compressive forces and protects the delicate turf. The vitality and durability of the grass is significantly improved, particularly by the substrate structure in which vegetation can grow, as its ability to retain water and nutrient supply are greatly improved. This also guarantees near-natural, decentralised rain water management with ground water protection.

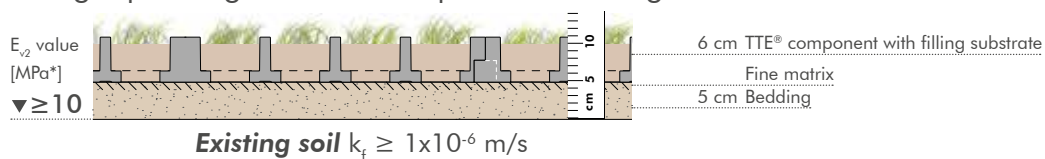
If nothing to the contrary has been defined in the plans and tender (taking into account the relevant regulations and standards) the requirements and specification of the TTE® construction method must be observed in order to ensure proper functioning. Please also refer to the planning assistance.



## TTE® Construction Methods According to Load

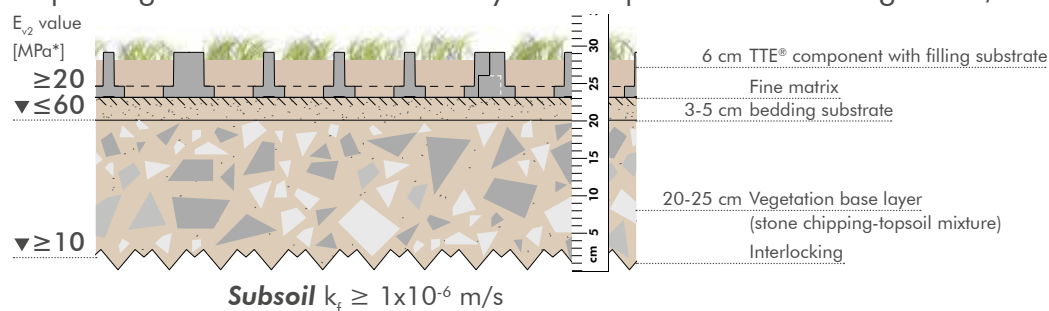
### TTE® Green 1

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



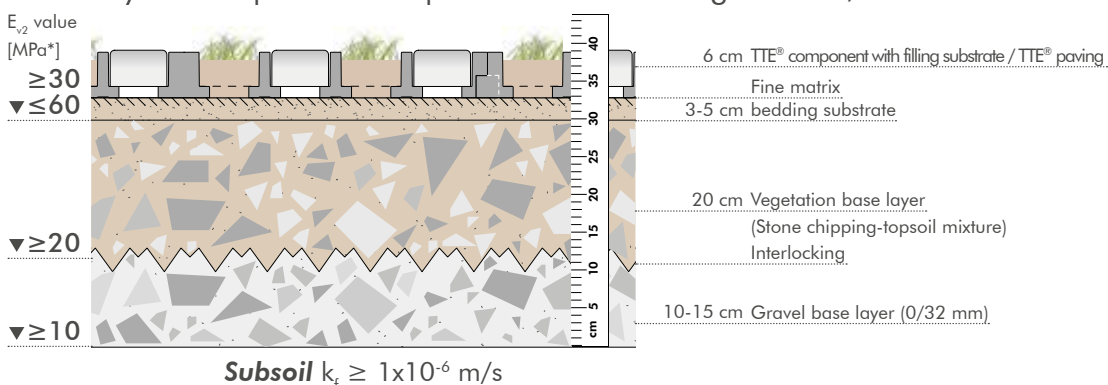
### TTE® Green 2

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



### TTE® Green 3

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



\*1 MPa = MN/m<sup>2</sup> <sup>1)</sup>German Road and Transport Research Association <sup>2)</sup>German Landscape Development and Landscape Design Research Society <sup>3)</sup>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 ( $\triangleq$ 28.80 m <sup>2</sup> )	1,560 pieces ( $\triangleq$ 15.6 m <sup>2</sup> laid TTE® surface)
max. quantity delivered per truck	864 m <sup>2</sup> (= 30 pallets)	390 m <sup>2</sup> (=25 pallets)
<b>Fine matrix</b> (separating mesh / installation aid)	24 g/m <sup>2</sup> , 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 topsoils 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  $k_f$  5 x 10<sup>-5</sup> m/s bis 5 x 10<sup>-6</sup> m/s
- Distance from the surface to the average highest groundwater level  $\geq 1$  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 + vegetation base layer	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<sub>v2</sub> value  $\leq 45$  MPa\***

	Rough estimation	Proof
<b>Assessing the load-bearing capacity</b>	DIN 18035-4 traffic test	Load plate pressure test in accordance with DIN 18134

	Field test	Laboratory test
<b>Permeability test</b>	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

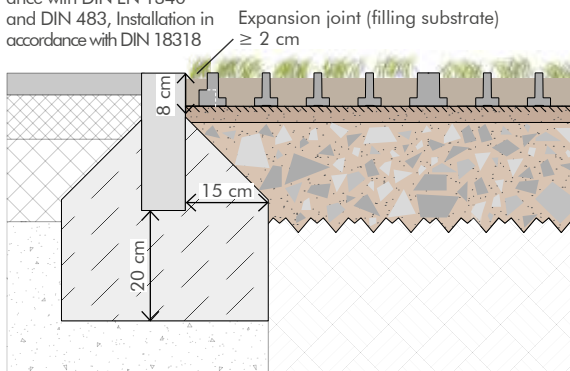
- If necessary, remove topsoils including planted land cover and ground true to profile according to layer thickness and connection heights
- Prepare the substructure in accordance with the TTE® building method requirements and ZTV E-StB

	TTE® Green Building Method 1	TTE® Green Building Method 2	TTE® Green Building Method 3
<b>Removal layer</b>	approx. 10 cm	30 cm (F <sub>1</sub> soils) to 35 cm (F <sub>2</sub> /F <sub>3</sub> soils)	40 cm (F <sub>1</sub> soils) to 45 cm (F <sub>2</sub> /F <sub>3</sub> soils)

\*1 MPa = MN/m<sup>2</sup>

# Edging

Concrete edge in accordance with DIN EN 1340 and DIN 483, Installation in accordance with DIN 18318



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, heavy-load traffic)

## Avoid slab cutting

Surface dimensions = grid dimension 40.15 cm x X rows + 2 x linking teeth (each 1.5 cm) + 2 x expansion joint (each  $\geq 2$  cm), determine the spacing by laying test rows.



# Vegetation Base Layer

- Supply gravel turf substrate 0/16 to 0/45 mm in accordance with the FLL directive<sup>4)</sup> as a ready-to-install substrate mix, or mix homogeneously as a mixed-in-place blend or by soil improvement (see planning assistance)
- Interlock with the subsoil or base layer
- Statically compact the vegetation base layer in an earth-moist condition in accordance with the requirements of the TTE<sup>®</sup> building method and TTE<sup>®</sup> guidelines

	F <sub>1</sub> soils	F <sub>2</sub> /F <sub>3</sub> soils	E <sub>v2</sub> load-bearing capability	E <sub>v2</sub> /E <sub>v1</sub> relationship
<b>TTE<sup>®</sup> Building Method 2</b>	20 cm vegetation base layer	25 cm vegetation base layer	$\geq 20$ MPa*	< 2.0
<b>TTE<sup>®</sup> Building Method 3</b>	20 cm vegetation base layer on 10 cm gravel base layer	20 cm vegetation base layer on 15 cm gravel base layer	$\geq 30$ MPa* $\geq 20$ MPa*	< 2.0



Vegetation base layer through soil improvement: Milling of gravel into the existing topsoil

## Recommended mixture

- 70 vol.-% crushed stone gravel 2/32 to 2/45 mm or gravel base layer 0/32 to 0/45 mm
- 15 vol.-% topsoil soil group 2 or 4
- 15 vol.-% quality-assured finished compost

**WARNING: Only use live topsoil (no subsoil) as an aggregate**

# Bedding Substrate

- Supply bedding 0/4 to 0/8 mm in accordance with FLL directive<sup>4)</sup> as a ready-to-lay substrate mixture, or mix homogeneously as a mixed-in-place mixture
- Remove bedding substrate in an earth-moist condition until level with a 3-5 cm layer thickness

## Recommended mixture

- 70 vol.-% stone chippings 2/4 to 2/8, 4/8 or 5/8 mm
- 15 vol.-% sifted topsoil BG 2 or BG 4 0-20 mm
- 15 vol.-% sifted finished compost, quality-assured 0-20 mm

## WARNING:

**Do not use any purely mineral material** (greatly affects the supply of water and nutrients)

\*1 MPa = MN/m<sup>2</sup> <sup>4)</sup> FLL directive for the planning, execution and maintenance of plantable pavers

# TTE<sup>®</sup> System

1. Lay the fine matrix (separating mesh) on to 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. Lay TTE<sup>®</sup> elements in head-on alignment. Observe types of bonds and place plates together without joints (for TTE<sup>®</sup> Green 3: 50% insert paving stones in a chequered pattern)
4. Insert TTE<sup>®</sup> paving stones (e.g. marking, footpath)
5. Sweep the filling substrate in cavities and expansion joints approx. 1.5 - 2 cm below top edge of grid
6. Compact the fully laid surface with a medium-weight plate compactor with apron => **setting approx. 2 cm**

## Laying Notes

- As a general rule, lay transversely to the direction of travel
- Move up the palletted TTE<sup>®</sup> elements as the laying progresses
- Lay a mixture of TTE<sup>®</sup> elements from multiple pallets
- In the case of marking and walkways lay TTE<sup>®</sup> paving stones prior to filling and cover as much as possible

**Installation rate: approx. 15-20 m<sup>2</sup>/person/hour** (format 80x40 cm, approx. 8.7 kg/piece)

Create expansion joints  $\geq 2$  cm from filling substrate between edging and TTE<sup>®</sup>



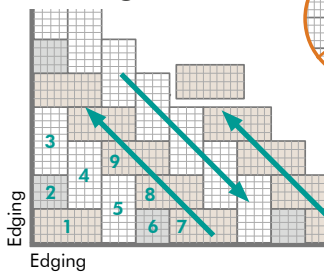
Laying of the TTE<sup>®</sup> elements on the fine matrix (installation aid)



Insertion of the TTE<sup>®</sup> paving stones e.g. for walkways and as marking

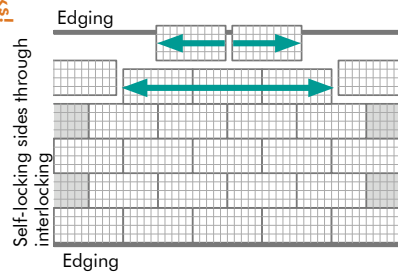
## Types of Bond

### Herringbone bond



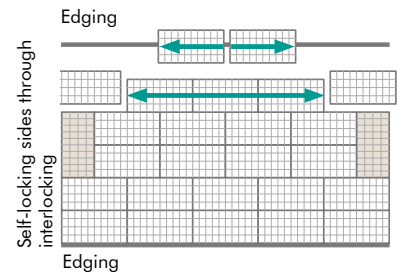
- **broad surface load** (e.g. events areas)
- Diagonal laying in alternating rows
- Circumferential edging required

### Stretcher Bond



- **linear load** (e.g. access 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 (beginning/end of laying)

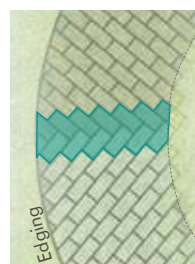
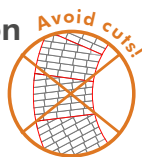
### Offset block bond



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

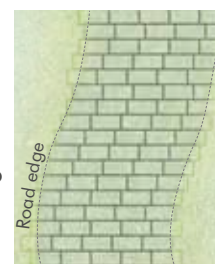
## change of direction

- 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

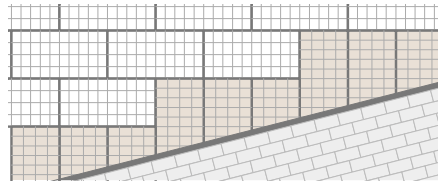


### soft bends

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

## 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



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

## Filling Substrate

- Supply 0/2 to 0/5 mm filling in accordance with the FLL directive<sup>4)</sup> as a ready-to-lay substrate mixture, or mix homogeneously as a mixed-in-place mixture
- Stop filling substrate in cavities and expansion joints approx. 1.5 - 2 cm below top edge of grid

### Recommended mixture

- 50 vol.-% sifted topsoil soil group 2 or 4 0-20 mm
- 30 vol.-% 0/2 mm washed sand
- 20 vol.-% quality-assured finished compost 0-20 mm

Filling material requirement [m<sup>3</sup>]  
 $\approx \text{area [m}^2\text{]} \times 0.04 \text{ m}$



In order to protect the vegetation, the **substrate must stop approx. 1.5 - 2 cm below the top edge of grid**



Insertion of the filling with a paver



Produce the underfilling using a sweeper

## Seeding

- Seed mix in accordance with DIN 18917 and regulation seed mixtures (RSM)
- Mix seeds with small quantities of filling substrate and sow evenly, seed quantity 25 g/m<sup>2</sup>, RSM 5.1 "parking area" or RSM 2.2 "In-use grass for dry locations" variety 2



Thick, lush vegetation thanks to ideal growing conditions



Green company parking area after 10 years of daily use

## Follow-Up Care

- Follow-up care in accordance with the FLL directive<sup>4)</sup>
- Depending on the weather, water grassy areas approx. 1-2 times per week, quantity per watering approx. 15 l/m<sup>2</sup>
- Fertilise the seeds approx. 2 weeks after sprouting, quantity approx. g/m<sup>2</sup>, pure N (if possible repeat after the 1st step)
- Mow the grass, growth height 6-10 cm, cut height 4 cm

<sup>4)</sup> FLL directive for the planning, execution and maintenance of plantable pavers