



INSTALLATION INSTRUCTION TTE® GREEN

 **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 to be retained and the thickness of the traffic-carrying surface and soil loss 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 FGSV¹⁾, FLL²⁾ and DWA³⁾ 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.

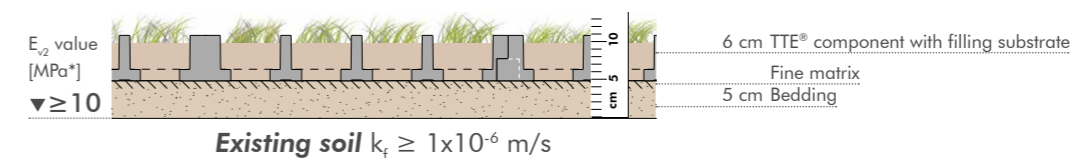
If nothing to the contrary has been defined in the plans and tender, the requirements and specifications of the TTE® construction method, taking into account the relevant regulations and standards, are to be observed in order to ensure proper functioning.

¹⁾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

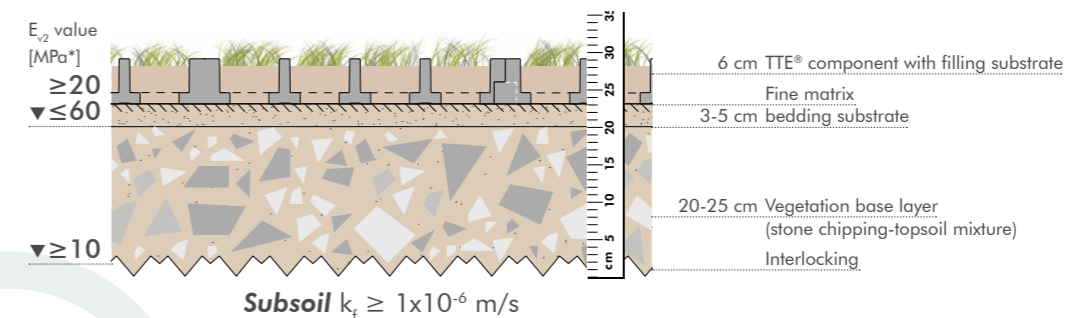
TTE® GREEN 1

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



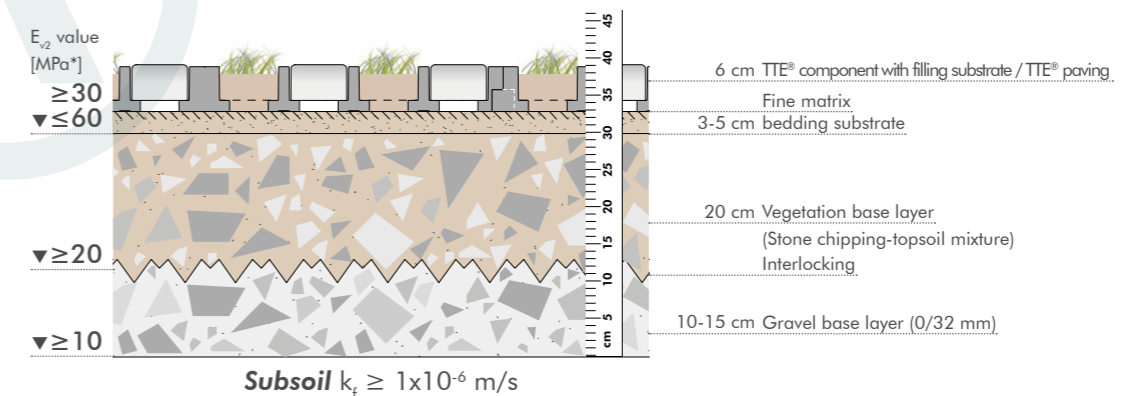
TTE® GREEN 2

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/m²

PACKAGING / PALLETISING

	TTE® components	TTE® paving stones
Pallet size	L x B x H 123 x 85 x 200 cm	L x B 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 pallets)	388.8 m ² (= 27 pallets)
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

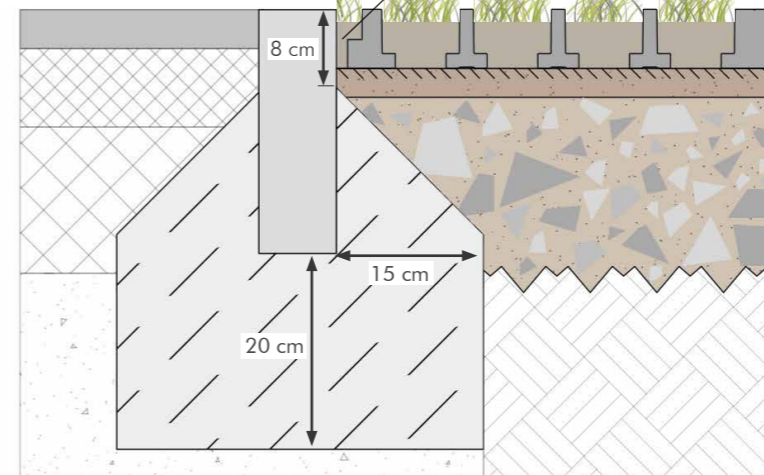
FOUNDATION SOIL

- 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 GREEN 1	TTE® construction method GREEN 2	TTE® construction method GREEN 3
Removal layer	approx. 10 cm	30 cm (F ₁ soils) 35 cm (F ₂ /F ₃ soils)	40 cm (F ₁ soils) 45 cm (F ₂ /F ₃ soils)

EDGING

Concrete edge in acc. with DIN EN 1340 and DIN 483; installation in acc. with DIN 18318



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.

BASE LAYER

- Supply gravel turf substrate 0/16 to 0/45 mm in acc. with the FLL directive⁴⁾ as a ready-to-install substrate mix, or mix homogeneously as a mixed-in-place blend or by soil improvement
- Interlock with subsoil or base layer
- Install vegetation base layer in soil-moist condition in accordance with the requirements of the TTE® construction method and FLL guideline⁴⁾ and statically compacted.

	F ₁ soils	F ₁ /F ₃ soils	E_{v2} load bearing capacity	E_{v2}/E_{v1} ratio
TTE® construction method 2	20 cm vegetation base layer	25 cm vegetation base layer	≥ 20 MPa*	< 2.0
TTE® construction method 3	20 cm vegetation base layer on 10 cm gravel base layer	20 cm vegetation base layer on 15 cm gravel base layer	≥ 30 MPa* ≥ 20 MPa*	< 2.0

¹⁾ MPa = MN/m²

RECOMMENDED MIXTURE

70 Vol.-% crushed stone gravel 2/32 to 2/45 mm or STS 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 directive⁴⁾ 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 to 5/8 mm
 15 Vol.-% sifted top soil 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)

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. For TTE® GREEN 3: insert 50% paving stones in a chequered pattern
4. Insert TTE® 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. 1.5 - 2 cm

LAYING NOTES

- Move up the palletted TTE® elements as the laying progresses
- Lay a mixture of TTE® elements from multiple pallets
- In the case of marking and walkways lay TTE® paving stones prior to filling and cover as much as possible

Installation rate: approx. 15 - 20 m²/person/hour (format 80 x 40 cm, approx. 8.7 kg/pc.)



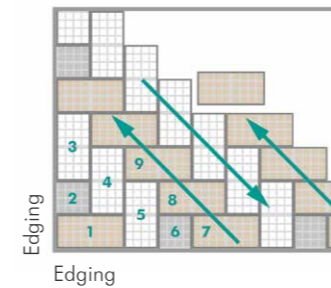
Laying of the TTE® elements on the fine matrix (installation aid).



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

TYPES OF BONDS

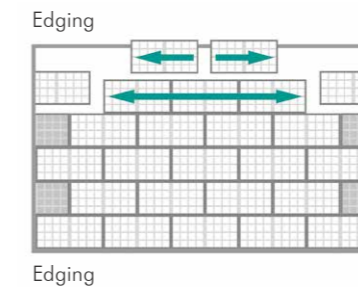
HERRINGBONE BOND STRETCHER BOND



Broad surface load

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

- Diagonal laying in alternating rows
- Circumferential edging required

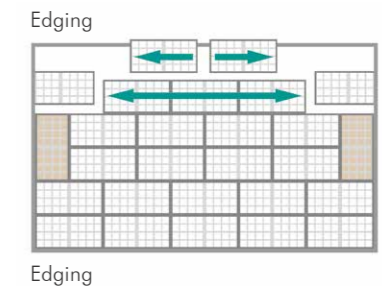


Linear load

(e.g. fire brigade access roads, drive-ways and roads)

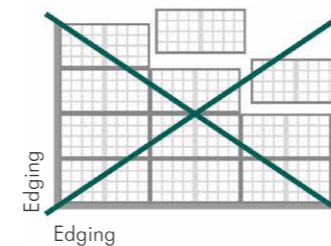
- Lay transversely to the direction of travel
- For pure fire brigade access roads, a lateral edging can be dispensed with.

OFFSET BLOCK BOND



Light load

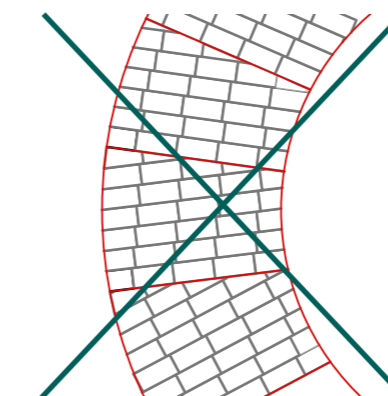
- Lay transversely to the direction of travel
- No intersecting of edging slabs
- Suitable for mechanical laying



NO CROSS JOINT LINKS!

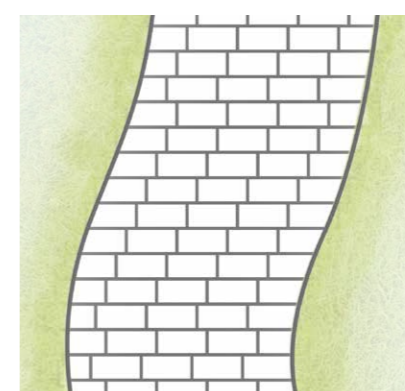
- Do not lay TTE® in a cross-joint bond, as this does not absorb shear forces well.
- This makes the surface more susceptible to the formation of unwanted joints

CHANGE OF DIRECTIONS



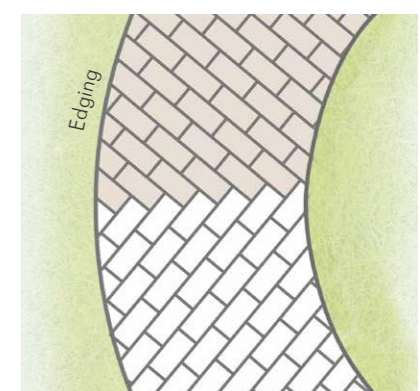
Avoid cuts

- 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)

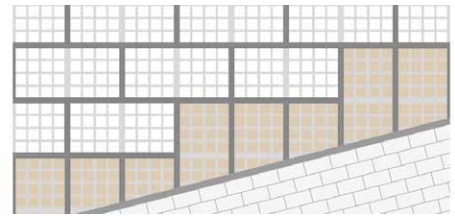


Sharp bends

- 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



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 directive⁴⁾ 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 [m³] ≈ area [m²] × 0.04 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)
Reccomendation: RSM 5.1 „parking area“ (25 g/m²) or RSM 2.2 „In-use grass for dry locations“ variety 2 (35 g/m²)
- If possible, have the substrate supplier mix the seed homogeneously into the filling substrate (RSM 5.1: approx. 3.5 kg/m² - RSM 2.2: approx. 2.5 kg/m²).
Alternatively, mix seed with filling substrate 1:1 and spread homogeneously according to sowing rate.



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 directive⁴⁾
- Depending on the weather, water grassy areas approx. 1-2 times per week, quantity per watering approx. 15 l/m²
- Fertilise the seeds approx. 2 weeks after sprouting, quantity approx. g/m², pure N (if possible repeat after the 1st step)
- Mow the grass, growth height 6-10 cm, cut height 4 cm

⁴⁾ FLL directive for the planning, execution and maintenance of plantable pavers