Specification, Design & Installation Guide

NEW BODPAVE™ 40 *For Gravel surfaces*

TERRAM® Geosynthetics you can trust

SDI/BP40/GF Issue 5 April 2022

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NEW BODPAVE™ 40

For Gravel surfaces

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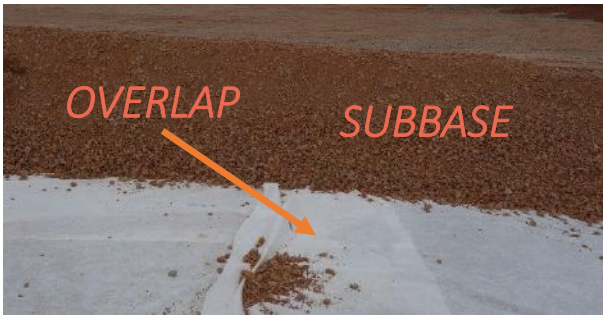
INSTALLATION

1. Excavate ground to the required formation level.
2. Unroll Terram all-in-one Bodgrid geocomposite (white geotextile below, black geogrid above) or Terram standard geotextile onto the prepared subgrade with a minimum of 300mm overlap at the joints.
3. Place and compact type 3 (*) open graded granular material on top of the Terram layer to the required compacted thickness determined by the designer (minimum 100mm) to form a strong permeable subbase layer.

* Type 3 is an open graded granular material as described in Specification for Highways Works clause 805. If a higher water storage (attenuation) capacity (void ratio) is required a hard crushed angular “clean stone” such as a course graded aggregate (CGA) type 4/20 (4 mm minimum and 20 mm maximum particle size) can be used. Traditional well graded type 1 aggregate (with suitable drainage) may be used to form the subbase layer as determined by the designer. For further guidance regarding drainage options and subbase materials see design notes and material specification sections.



INSTALLATION continued

4. Install edge restraints as specified; traditional precast concrete kerbs, steel, plastic or treated timber boards/sleepers.

5. Install a second layer of Terram standard geotextile or Inbitex™ on top of the subbase with a minimum of 300mm overlap at the joints.

6. Place, compact and screed granular bedding material (angular gravel or grit sand) to a minimum uniform thickness of 35mm. See material specification section for more guidance on suitable bedding materials. The use of rounded pea shingle/gravel is not recommended.

INSTALLATION continued

7. Start in the corner of the longest straight edge (kerb) leaving a 25mm expansion gap around the perimeter.

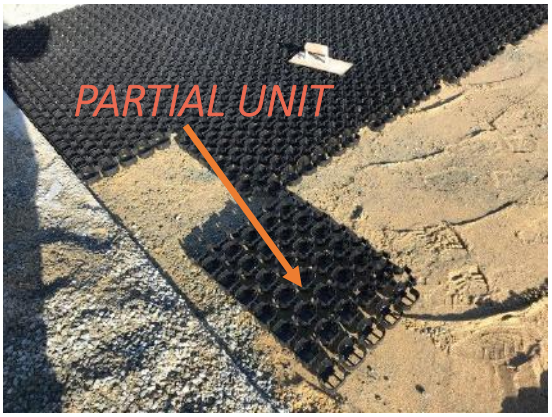
8. Place pre-connected set of four Bodpave units (1m x 1m) with the loop connectors facing outwards as a “leading edge” towards the remainder of the prepared bedding layer . Apply firm pressure so that the ground spikes are pressed fully into the bedding and the base of the units sit flat on the bedding layer surface.

9. Connect adjacent Bodpave units together by slotting the edge half cells down into the edge loops. Progress in rows (LOOPS ALWAYS LEAD) locking units in place with firm pressure over the snap–fit clips. If separation is required, clips can be dislocated using careful, firm hand or screwdriver pressure or by gently twisting the pavers.

INSTALLATION continued

10. Cut Pavers to fit around obstructions and at the end of rows using a fine toothed hand or circular power saw. Partial units should be fixed using snap-fit clips and additional UV resistant nylon cable ties.
11. Install snap-fit markers as required before filling Bodpave units.
12. Once all Bodpave units have been installed, fill pavers with clean angular aggregate gravel chippings level with the top of the units—do not overfill. A light vibrating plate compactor may be used to consolidate the pavers and settle the fill. Top up the cells as required after settlement. The use of rounded pea shingle/ gravel is not recommended.
13. The surface may be trafficked immediately.

MARKERS

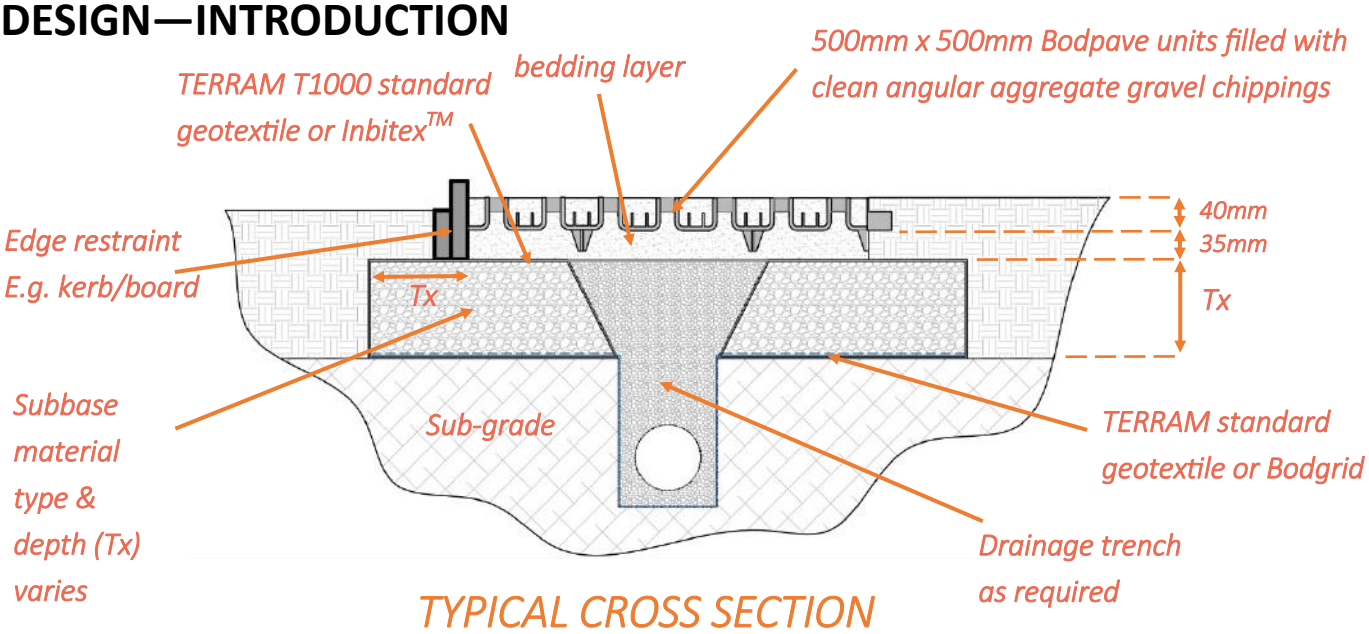


MAINTENANCE

A gravel filled Terram Bodpave 40 porous surface should last for many years with very little maintenance. The long-term performance of a Terram Bodpave system is dependant upon many factors including the frequency and intensity of traffic loading, adjacent or overhanging vegetation and the initial subbase construction. The following maintenance should be considered:-

1. Debris - fallen leaves, sticks and other debris should be removed from the surface as needed.
2. Weeds - ideally removed by hand or using a biodegradable weed killer once or twice a year.
3. Gravel spread and settlement - regularly inspect areas of Bodpave porous surfacing subject to regular turning and channelised traffic. Rake or brush the gravel back into the Bodpave units or top up with fresh clean angular aggregate gravel chippings as required. Failure to top up regularly trafficked Bodpave units with gravel may result in lateral movement, lifting and ultimately failure of the system.
4. Speed, weight and height restrictions should be placed on all vehicles trafficking a Bodpave porous surface. Heavy vehicles, excessive braking, turning and accelerating may cause damage.
5. If Bodpave units are damaged consult with Terram for advice on repair.

DESIGN—INTRODUCTION



TYPICAL CROSS SECTION

Terram Bodpave™ is the original interlocking cellular porous plastic paving grid system for ground surface stabilisation. Typical applications include car and light vehicle parking, pedestrian walkways, golf buggy paths, cycle paths, driveways and residential parking. The porous surface makes Bodpave units ideal for use within a source control permeable paving SUDS (Sustainable Drainage System). Most Bodpave installations will require a new subbase (pavement foundation layer) to be constructed. The thickness and type of granular material used to form the subbase will generally depend on the following factors:-

1. Strength of the underlying ground (subgrade) measured in CBR* %
2. Water permeability of the underlying ground (subgrade) k measured in m/s
3. Type of underlying ground (subgrade) E.g. clay/silt/sand/gravel/rock
4. Type of vehicle traffic (HGV/LGV/car/cycles/pedestrian)
5. Frequency of traffic (occasional/regular)

*California Bearing Ratio test

A comprehensive ground investigation survey with suitable testing is highly recommended to ensure the subbase for a Bodpave surface is suitably strong and sufficiently durable for the anticipated use. **This design guide can be used for estimating ground conditions and producing preliminary pavement designs but it is not a substitute for site specific ground investigation works and a detailed pavement design by a suitably qualified civil engineer.**

DESIGN continued

TABLE 1 MINIMUM SUBBASE THICKNESS (Tx) WITH BODGRID

SUBGRADE	Cars/ light vehicles (#)		Coaches/Heavy goods/emergency vehicles (#)		Overlap
CBR* %	Thickness (mm)	Bodgrid	Thickness (mm)	Bodgrid	(mm)
1	300	GC30	400	GC30	600
2	150	GC30	250	GC30	500
3	125	GC30	175	GC30	450
4	125	GC30	150	GC30	400
5+	100	GC30	125	GC30	300

TABLE 2 MINIMUM SUBBASE THICKNESS (Tx) WITHOUT BODGRID

SUBGRADE	Cars/ light vehicles (#)		Coaches/Heavy goods/emergency vehicles (#)		Overlap
CBR* %	Thickness (mm)	Standard geotextile	Thickness (mm)	Standard geotextile	(mm)
1	450	T2000	600	T2000	600
2	225	T1500	375	T1500	500
3	200	T1000	300	T1000	450
4	200	T1000	225	T1000	400
5+	150	T1000	200	T1000	300

* California Bearing Ratio test

Regular tight turning of vehicles and "dry" steering may cause damage to the Bodpave units and/or displace gravel infill; vehicle manoeuvring should be carefully considered at specification/design stage. Gravel filled units may require some maintenance when subjected to regular channelised and turning traffic loadings. Terram Bodpave™ 85 and Truckpave™ paviours are generally recommended for occasional overrun or regular HGV traffic respectively. If construction traffic axle load exceeds 60kN (6 Tonnes), minimum subbase thickness over TERRAM Bodgrid should be 200mm.

TERRAM Bodgrid

TERRAM standard geotextile

DESIGN continued

TABLE 3 FIELD GUIDANCE FOR ESTIMATING SUBGRADE STRENGTH

Consistency	Indicator		Strength		
	Tactile (feel)	Visual (observation)	Mechanical (test) SPT	CBR %	Cu Kn/SQM
Very Soft	Hand sample squeezes through fingers	Person standing will sink >75mm	<2	<1	<25
Soft	Easily moulded by finger pressure	Person walking sinks 50-70mm	2-4	~1	~25
Medium	Moulded by moderate finger pressure	Person walking sinks 25mm	4-8	1-2	25-40
Firm	Moulded by strong finger pressure	Utility truck ruts 10-25mm	8-15	2-4	40-75
Stiff	Cannot be moulded but can be indented by thumb	Loaded construction vehicle ruts by 25mm	15-30	4-6	75-150

TABLE 4 TYPICAL SOIL TYPES AND PROPERTIES

Soil Type	Plasticity Index %	CBR% Depth of water table below formation level		Typical range for coefficient of permeability	Infiltration
		>600mm	<600mm	K (m/s)	
Heavy clay	70 60 50 40	2 2 2.5 3	1 1.5 2 2	10^{-10} to 10^{-8}	No
Silty clay	30	5	3	10^{-9} to 10^{-8}	No
Sandy clay	20 10	6 7	4 5	10^{-9} to 10^{-6}	Partial
Silt	Non-plastic	2	1	10^{-8} to 10^{-6}	Partial
Poorly graded sand	Non-plastic	20	10	10^{-7} to 10^{-6}	Partial
Well graded sand	Non-plastic	40	15	10^{-6} to 10^{-4}	Total
Well graded sandy gravel	Non-plastic	60	20	10^{-5} to 10^{-3}	Total

CLAY

SILT

SANDY GRAVEL

This field guide is provided as an aid to assessing the mechanical stabilisation requirements in commonly encountered site conditions. TERRAM accepts no responsibility for any loss or damage resulting from the use of this guide.

DESIGN NOTES

1. Minimum subbase thickness (Tx) can be selected from table 1 or 2 with ground strength and permeability estimated from tables 3 and 4 in the absence of any site specific ground investigation report.

2. If the Terram **Bodgrid** layer is omitted, then the total subbase layer thickness (Tx) must be increased by 50%. A Terram standard geotextile separation layer should be specified with lower subgrade strength (CBR value) requiring a more robust grade in accordance with BS8661:2019 (see table 2).

3. Bodpave units are an ideal surface for source control porous paving SUDS (Sustainable Drainage Systems) with a permeable subbase; **DoT Type 3** (Type 1x) porous/open graded granular material as described in Specification for Highways Works clause 805. If a higher water storage (attenuation) capacity (void ratio) is required a hard crushed angular "clean stone" such as a course graded aggregate (**CGA**) **type 4/20** (4 mm minimum and 20 mm maximum particle size) can be used. The type of SUDS design (attenuation, total or partial infiltration) will depend upon the underlying ground conditions and not all sites are suitable for infiltration. Weak and low-permeability cohesive subgrades are generally unsuitable for infiltration (permeability coefficient k $<10^{-6}$ m/s). Clays with a low plasticity index (<20%) will reduce in strength when saturated; a full attenuation system with an impermeable membrane directly on top of the subgrade is recommended (See table 4). Specific advice on suitable drainage and construction over very weak ground (CBR <1%) is available from TERRAM.

4. Alternatively traditional '**DoT Type 1'** well graded granular material may be used for the subbase provided that an adequate drainage system is installed. Typical drainage details; 100mm diameter perforated pipe drain laid at minimum gradient 1:100, bedded on gravel in trench backfilled with SHW Clause 505 '**Type A'** drainage aggregate (or **CGA type 4/20**), covered or wrapped with **Terram T1000** standard nonwoven geotextile and leading to a suitable outfall or soakaway. Drains placed down the centre or along the edge of access routes up to 5m wide. Wider areas may require additional drains at 5m - 10m centres.

5. The subbase must be covered with a layer of **Terram T1000** standard or **Inbitex™** nonwoven geotextile to prevent settlement due to mixing of the bedding & subbase layers and to provide filtration & pollution control.

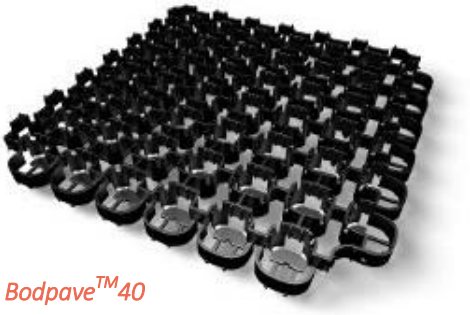
6. The final pavement and drainage design should be undertaken by a suitably qualified civil engineer and based on specific site conditions.

7. Maximum advised gradient for traffic applications is 12% (1:8) 7º , Bodpave units have specific fixing points for **steel u-pins** if required for steep slope applications.

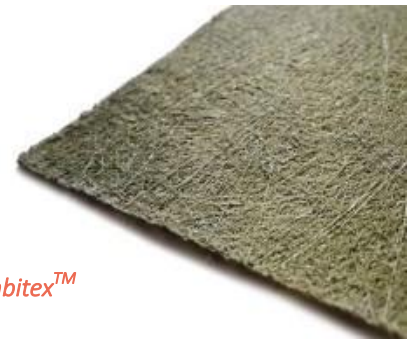
MATERIAL SPECIFICATIONS

TABLE 5 Terram products

TERRAM BODPAVE™40	
Dimensions	500mm x 500mm x 40mm + 20mm ground spike
Compressive strength	<250tonnes (2450kN)/SQM (gravel filled)
Connection strength	7kN/Lm
Material	100% recycled plastic
Coverage	4 units/SQM
Inbitex™ nonwoven geotextile	
Standard roll dimensions	4.5m wide x 100m long
Tensile strength kN/m	8.5
Elongation	30%
CBR puncture resistance kN	1.6
Oil absorption and removal	<400g/SQM_year
TERRAM nonwoven standard geotextile	
Standard roll dimensions	4.5m x 100m long
Grades	T1000/T1500/T2000
BS8661 Classification	1 /2/ 3
Tensile strength kN/m	8.0/12.5/14.5
Elongation	60%
CBR puncture resistance kN	1.5/2.25/2.75
TERRAM BODGRID GC30	
Standard roll dimensions	4.8m wide x 50m long
Tensile strength kN	30
Tensile elongation	7%
Functions	Separation, filtration, stabilisation

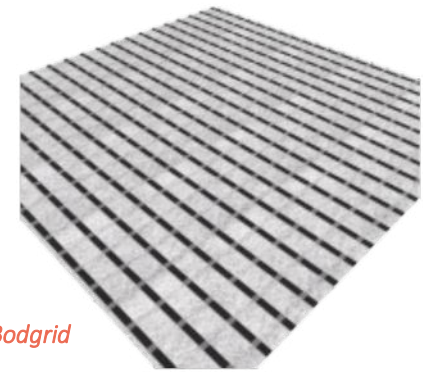


Bodpave™40



Inbitex™

Standard geotextile



Bodgrid

Inbitex™ is a licensed trademark of Forterra (Hanson) Building Products Ltd

MATERIAL SPECIFICATIONS

TABLE 6 Fill materials

Bodpave surface fill	
Description	Clean angular hard aggregate gravel chippings
Aggregate size	6 to 10mm
Typical source quarried rocks	Granite, basalt, hard limestone
Grading to BS EN 13242	Gc 80/20 6/10
Comments	**Rounded pea shingle is not suitable**
Bedding layer (2 options)	
Description	Option 1—clean hard angular aggregate gravel chippings
Aggregate size	6 to 10mm
Typical source quarried rocks	Granite, basalt, hard limestone
Grading to BS EN 13242 or 12620	Gc 80/20 6/10
Comments	Rounded pea shingle is not suitable
Description	Option 2—course grit (sharp) sand
Aggregate size	0 to 4mm
Grading to BS EN 13242 or 12620	Gc 85 0/4 Site category II <1.5% fines (0.063mm)
Subbase (3 options)	
Description	**Option 1**—well graded granular DoT **Type 1 (**with filter drains)
Aggregate size	0 < 63mm
Grading to BS EN 13242 or 12620	Gc 75/32 1/31.5 (SHW Clause 803)
Description	**Option 2—permeable** open graded granular DoT **Type 3** (Type 1x)
Aggregate size	0 to 40mm
Grading to BS EN 13242 or 12620	Gc 80/25 1/40 (SHW Clause 805)
Description	**Option 3—clean stone**, course graded aggregate type 4/20
Aggregate size	4 to 20 mm
Grading to BS EN 13242 or 12620	Gc 90/15 4/20

UNCOMPACTED *COMPACTED*

Angular gravel chippings

~~*Pea shingle*~~

Course grit sand

Type 1

Type 3 (1x) - permeable

CGA type 4/20 (Clean stone) - permeable

UNCOMPACTED *COMPACTED*