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POSSIBILITIES OF THE APPLICATION OF MAT GEOCOMPOSITES AND SPATIAL CELLULAR SYSTEMS IN THE CONSTRUCTION AND MODERNISATION OF EMBANKMENTS

MAT Geocomposite is an innovative solution whose aim is to improve the safety of embankments and to lower the cost of their modernisation. This task is realised by means of supporting the growth of plants on embankments, constituting anti-erosion protection. Mat Geocomposite, combined with spatial cellular systems, is a system that is easy to install and effective and may be used for the construction and modernisation of embankments. It can also be successfully applied on slopes and inclinations.

STRUCTURE OF THE GEOCOMPOSITE

Mat Geocomposite consists of a flexible, spatial mat, which, after spreading, is anchored to the soil of the slope and then filled with the expanded mixture of superabsorbents (SAP) and separated from the fertile soil with geotextile. The geotextile on the edges of the mat belt is anchored with U-shaped steel pins. **Mat Geocomposite, applied in the soil under the root system of plants, captures and retains up to 20 l of rainwater per 1 sqm. of the reinforced surface.**

The geocomposite should be placed in the lower part of the humus layer, so that it allows the root systems of the reinforcing plants to grow through it. **Mat Geocomposite, as an element retaining water during droughts will support the development of the plant coverage.**

The skeleton of Mat Geocomposite is a mat made from HDPE, PP or PE, of a dimpled structure. Loading the mat with a layer of fertile soil does not affect the geocomposite's retention capacity.

The structure of Mat Geocomposite enables it to capture and retain water penetrating through the soil. Water collected from Mat Geocomposite by the root system of plants is gradually replenished during rainfall. With use of the moisture reserve contained in Mat Geocomposite plants are able to root better and to remain in better condition, which in turn allows them to provide anti-erosion resistance of the protection for several subsequent years.

TECHNICAL PARAMETERS OF MAT GEOCOMPOSITE

Technical parameters of the spatial mat

Depending on the inclination and length of the slope and on the thickness of the layer of fertile soil, the appropriate type of spatial mat should be selected. Properties of different types of spatial mats are presented in Table 1 (Technical approval by IBDiM (Road and Bridge Research Institute) No. AT/2009-03-1711).

Item	Properties	Unit	Requirements for spatial mat [1]								Test method according to
			variant 93	variant 10/10	variant 20/20	variant 35/20	variant 35/35	variant 55/30	variant 55/55	variant 65/30	
1	2	3	4	4	5	6	7	8	9	10	11
1	Surface mass	g/m^2	780 (±50)	780 (±50)	800 (±50)	820 (±50)	900 (±70)	920 (±100)	980 (±100)	960 (±100)	PN-EN ISO 9864:2007
2	Thickness	mm	21 (±2)	21 (±2)	21 (±2)	21 (±2)	21 (±2)	21 (±2)	21 (±2)	21 (±2)	PN-EN ISO 9863:2007
3	Tensile strength2) - along the band - across the band	 kN/m kN/m	 1,1 (-0,4) 1,3 (-0,3)	 13 (-3) 13 (-3)	 25 (-5) 25 (-5)	 40 (-5) 25 (-5)	 40 (-5) 40 (-5)	 60 (-5) 35 (-5)	 60 (-5) 60 (-5)	 70 (-5) 35 (-5)	
4	relative extension at maximum load: - along the band - across the band	 % %	 60.0 (±20.0) 80.0 (±20.0)	 13.0 (±3.0) 13.0 (±3.0)	 12.0 (±3.0) 12.5 (±2.5)	 12.0 (±3.0) 12.5 (±2.5)	 12.5 (±2.5) 12.5 (±2.5)	 13.0 (±2.5) 12.5 (±3.0)	 13.0 (±2.5) 13.0 (±2.5)	 13.0 (±2.5) 13.0 (±2.5)	PN-EN ISO 10319:2008

[1] acceptable deviations are shown in brackets
[2] lack of "+" sign tolerance means lack of limitations in"+" direction

Technical parameters of superabsorbent

The water-sorbing agent is a mixture of superabsorbents in form of cross-linked potassium salt of acrylic acid.

Item	Indicator name	Measurement unit	Indicator value
1.	Grain size distribution	mm	0.2 – 4.0
2.	Appearance	-	Powdery. white granules
3.	Volume density [kg/m3]	g/dcm^3	460 - 570
4.	Solubility	-	Not soluble in water. in contact with water solutions expands in form of gel
5.	pH (1g/l $H_2$0)	-	7.0 – 8.0
6.	Minimum heave – in free expansion conditions		
	- deionised water	cm^3/g	240 - 250
	- tap water (1.3 mmol/l CaCO3)	cm^3/g	160 - 180
7.	Toxicology/ecology	-	Pursuant to OECD tests – non-toxic for plants. soil organisms and ground water

*OECD - *Organization for Economic Co-operation and Development*.

Technical parameters of the geotextile

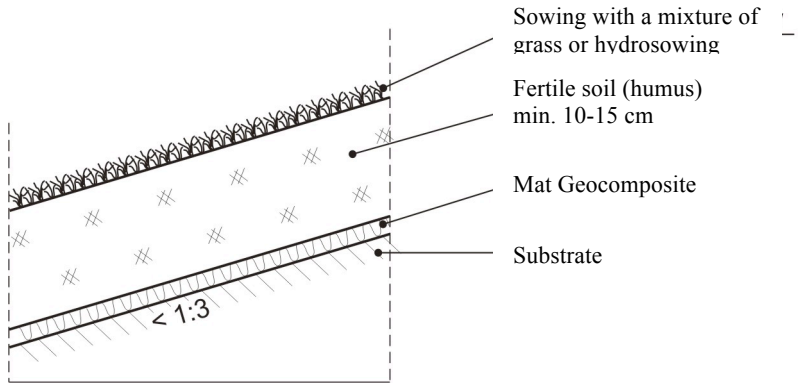
In order to separate the spatial mat from the fertile soil layer and to provide space for free expansion of superabsorbents, geotextile of high water conductivity should be applied.

Item	Indicator name	Measurement unit	Indicator value	Test method
1.	Composition of raw material	-	100% PES (polyester)	
2.	Surface mass	g/m2	150 (-10.+10)%	PN – EN ISO 9864
3.	Thickness (under 2.0 kPa load)	mm	2.5 ± 0.5 mm	PN – EN ISO 9863-1

CONDITIONS OF APPLICATION of Mat Geocomposite

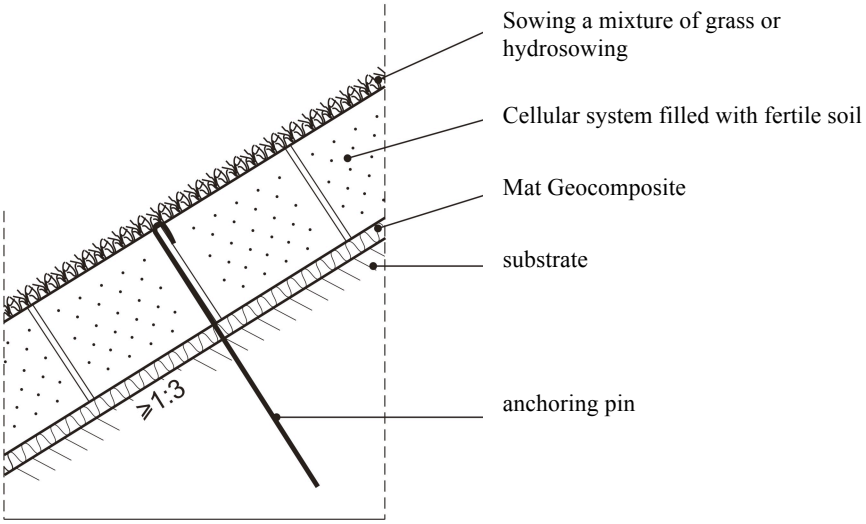
Turf covers of embankments of slope inclination 1:3 or lower

In the case of reinforcements of an inclination lower than 1 : 3. on dry, sandy soils, on barren, highly compacted soil screens and drainages that do not provide appropriate growth conditions for plants, it is beneficial to apply Geocomposite Mat under the layer of fertile soil, only to prevent the turf from drying so that, in case of overflowing of water it constitutes an anti-erosion cover protecting the slope.



Turf covers on anchored spatial cellular systems

In the case of reinforcements of an inclination higher than 1 : 3, on slopes separated with geomembranes, on steep drainage slopes and on slopes and inclinations capturing a large volume of surface runoff it is necessary to apply spatial cellular systems to maintain fertile soil. The application of Mat geocomposite under the layer of soil filling the cellular system guarantees good growth of the cover vegetation and strong development of its root systems.
In the case of slopes separated by geomembrane, the size and shape of geocomposite elements should be adapted to the space separated by the shape and size of cells of the system placed on top of the geomembrane.



Grass seeds are introduced on slope surfaced covered with humus with use of traditional sowing or hydrosowing. On reinforcements where it is required to obtain turf cover very soon, grass in rolls may be installed.

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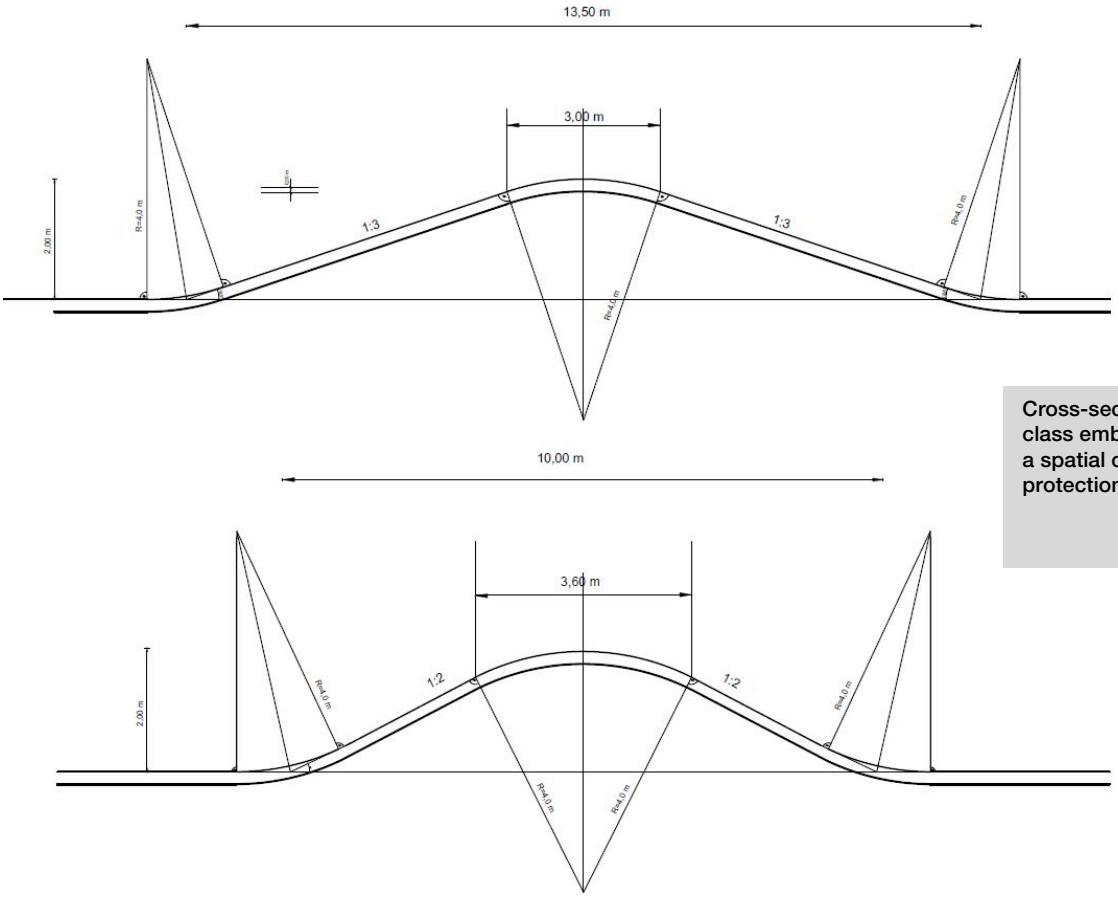
Low 3rd and 4th class embankments can be treated as land bulges in the river valley, used as a meadow. The cellular system placed on the embankment, on Mat Geocomposite, enables free vehicle traffic on the outside of the dikes (hay-cutting) and allows for the creation of a durable cover, which:

- ✓ As far as existing embankments are concerned, with little levelling works on the embankment, allows to obtain a durable structure with use of local earth material.
- ✓ For newly constructed embankments, where the soil is embedded pursuant to standard class requirements, the combination of Mat Geocomposite with cellular system creates the perfect conditions for obtaining permanent turf cover that creates useful biomass and is resistant to the overflow of flood waters.

The cellular system may be filled with local soil obtained from existing deposits, soil from the area between dikes or dredging material from the bottom of the water course. The whole surface should be covered with an at least 3-5 cm thick layer of humus and sown with a mixture of grass or with use of hydrosowing.
The composition of grass seeds should be selected adequately to match the habitat conditions (type of soil, exposure and inclination of slopes).

If it is necessary to designate a section of the embankment, through which flood waters may overflow to a previously prepared polder, the combination of Mat Geocomposite and spatial cellular system can also be applied. In such case it should be at least 30 cm high. After it is overgrown by grass roots, it may constitute an alternative solution to rip-rap reinforcements or gabion mattresses.



Cross-sections of 3rd and 4th class embankments with use of a spatial cellular system for the protection of slopes

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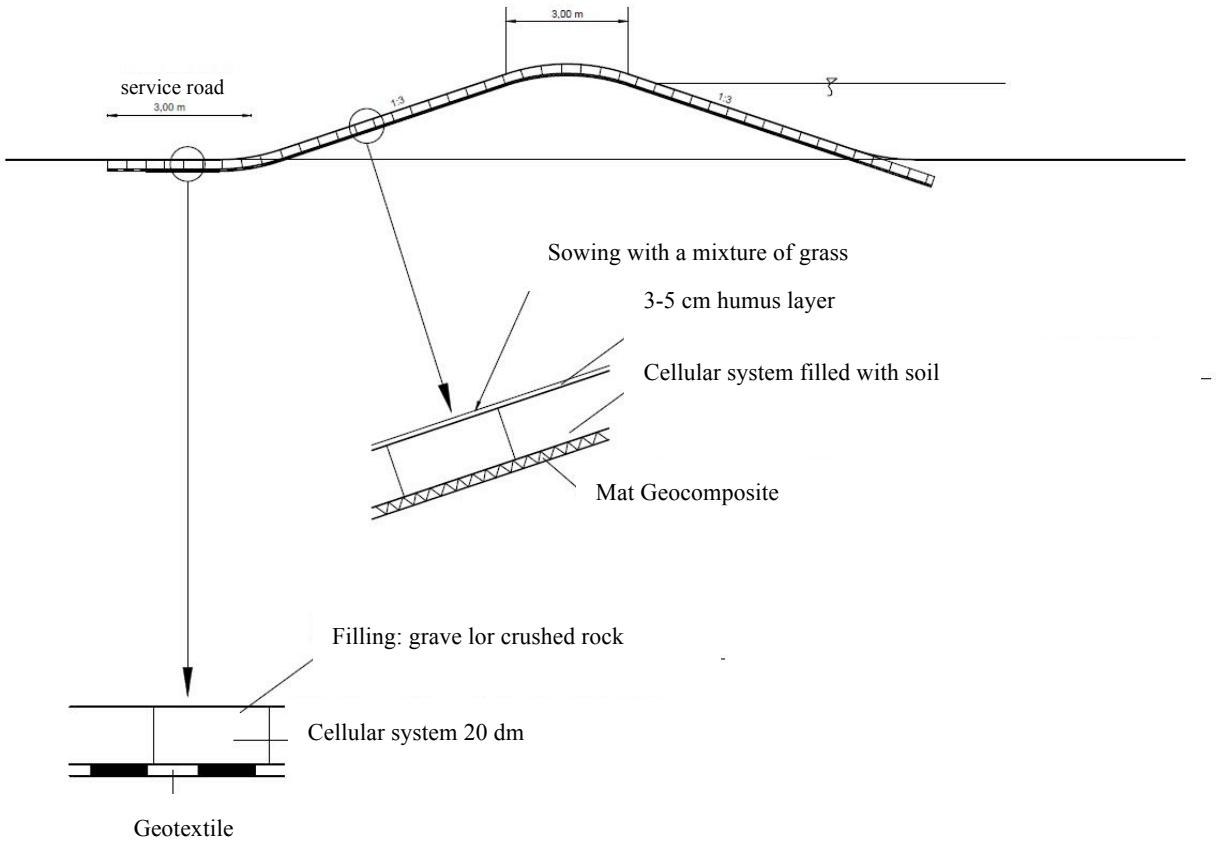

WATER ABSORBING GEOCOMPOSITE

- Innovative technologies supporting the vegetation of plants.

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www.geosap.up.wroc.pl

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