T-KONSULT

03.06.2018

Study Report:

In 2012 Estonian Road Administration initiated a study to find out the cost effective dust control and stabilizatrion method for Estonian gravel roads. Ramboll Estonia AS carried out the first phase of this study. Based on this study the stabilization methods, which will be tested in the second phase of this study in 2013-2014, were proposed. Additionally the soil stabilisation materials and methods were proposed to test for construction of dust-free on low-and high-volume roads.
The goal was to make the gravel road dust-free, increase its carrying capacity and compression strength. It was also a goal to make stabilized soil water and frost resistant.

The effectivness of various soil stabilisation materials and methods was evaluated and compared based on the results and data of visual monitoring, laboratory tests, measurements and cost benefit analysis carried out.

Two different soil stabilisation materials and methods were tested (third selection was dropped on early phase) on two 5000 m long and 6 m wide test sections on gravel road. Soil stabilisation with StabilRoad® material system and cement was performed on one test section and solution mixed with M10+50™ and LBS polymers was used with cement on second section. A half of the stabilised test section was covered with surface dressing and other part has left unsealed to better evaluate the changes of condition of stabilised gravel course.
The evenness of road surface was better on the test sections with surface dressings

As foreseen in the terms of reference of this study the test sections should be monitored how they withstand under the winter conditions

Thickness of the stabilizing layer: 35 cm
Mix ratio: 182 kg/m3
Cement: 63,7 kg/m2,
StabilRoad: 1,65 kg/m2

Table 8. The evenness of the stabilized and coated gravel sections

Lõik	Material	IRI mm/m		
		Direction 1	Direction 2	Average
1	Surface dressing with non-graded crushed stone aggregate 0/16	3,14	2,82	2,98
2	**Soil stabilisation with StabilRoad® material system and cement**	**2,58**	**2,81**	**2,70**
3	Soil stabilisation with polymers M10+50™, LBS and cement	3,66	3,23	3,45

Table 9. Load bearing capacity of stabilized and coated gravel sections

Test section	Material	E_{mod} Mpa						
		Direction 1			Direction 2			Section average
		Min	Max	Ave-rage	Min	Max	Ave-rage	
1	Surface dressing with non-graded crushed stone aggregate 0/16	83	134	114	99	155	133	124
2	**Soil stabilisation with StabilRoad® material system and cement**	**459**	**704**	**586**	**456**	**623**	**551**	**569**
3	Soil stabilisation with polymers M10+50™, LBS and cement	274	361	311	309	399	333	322

Table 2. Results of the measurements of soil stabilisation effectivenness characteristics

Test section	Material	Compressive strength	Bearing capacity E_{mod} avg	Evenness IRI avg
		Mpa	Mpa	mm/m
1	Surface dressing with non-graded crushed stone aggregate 0/16	-	124	2,98
2	**Soil stabilisation with StabilRoad® material system and cement**	**13,4**	**569**	**2,70**
3	Soil stabilisation with polymers M10+50™, LBS and cement	4,5	322	3,45

Picture 20. Soil stabilization with StabilRoad® and cement

Picture 21. Surface after stabilization with StabilRoad® and cement

Picture 28. Gravel road stabilized with StabilRoad® and cement

Picture 29. Gravel road stabilized with StabilRoad® and cement and coated after

5 YEARS AFTER THE USE OF STABILIZED ROAD (temperature ranges between max. +30^{0}C and min.-25^{0}C) THE LABORATORY RESULTS SHOWS TO THE FOLLOWING:

- The technical comparison showed that the bearing capacity (FWD) of road with stabilized layer of StabilRoad® has increased from 569 MPa to 599 MPa, while the load capacity of the M10 + 50™ has dropped from 322 MPa to 269 MPa
- The Laboratory comparison showed that the compressive strength of stabilized layer with StabilRoad® has increased from 13,4 MPa to 15,1 MPa, while the compressive strength of the M10 + 50TM has dropped from 4,5 MPa to 0 Mpa (the soil was the same as before the stabilization)

Conclusions from the test:

1) M10+50™ test failed, the material is initially designed to be used for fine grained sands (used during Kuwait war to prepare military airfields). Possible reason of failure – grain curve contained too little fine particles.
2) StabilRoad® test was technically successful and the end result is great. Obviously the Binder concentration requires optimization, to meet the required bearing capacity without overdimensioning. For gravel roads (daily traffic below 1000 vehicles/day), bearing capacity of about 300 MPa is sufficient (compressive strength not exceeding 10 MPa). In particular test, Binder concentration was not even also for a reason, that standard spreaders were used for StabilRoad®. (Stehr SBS 3000 or similar is required)

(Another example, particularly, negative, concerns the shale ash stabilization. Ash reduces initial strength, but the increase within time is much longer and final strength higher. Experience is negative because the stronger the material is, larger monolites form with hydraulic Binder, and temperature changes are causing cracks in material. It is extremely important to optimize the Binder content so, that the cracks which appear, will be small, monolite not forming too large, but on the same, necessary compressive strength is achieved.)

Long term performance:

All layers with hydraulic Binder (cement) are improving in time – afterhardening process. The process develops in logarithmic scale – yearly increase continuously reducing.
And StabilRoad® gives the basic benefits.

Estonian and Finnish experience in concrete roads is one good example – from initial 60 MPa compressive strength on road concrete, within 10 years the strength increased to over 100 MPa level. (Very different temperature and climate conditions)

In Conclusion:

- **Soil that was stabilized with StabilRoad® technology 5 years ago is still extremely durable today.**
- **Specially over the different seasons of the year, with very different temperatures and rainfalls.**
- **The road still does not require any maintenance.**
- **And it can be firmly asserted that maintenance will not be needed for many more years.**

Teede Tehnokeskus

EAK EESTI AKREDITEERIMISKESKUS ESTONIAN ACCREDITATION CENTRE
EN ISO/IEC 17025
L036

TEST REPORT
№ 8744/13

24.08.2013 № 3-2.5/3445

Client:	Ramboll EestI AS
Description of job:	Testing of stabilized soils

Samples:

Object	Põltsamaa
Place of Sampling	Põltsamaa

Date of taking samples and sampler	**Date of delivering samples and deliverer**
20.07.2013 ,	20.07.2013 ,
AS Teede Tehnokeskus	AS Teede Tehnokeskus
Clients marking of samples	**Reg. Number in laboratory**
Section stabilized with StabilRoad	2786

Testing and results

The surfaces of cores were smoothened by sawing.
The specimens were held in a climate room in temperature 20±2 °C, relative humidity 65±5 %. The density of samples (without drying) was determined according to EVS-EN 12697-6 (method D). Compressive strength was determined according to *EVS-EN 13286-41.
* – not accredited by Estonian Accreditation Centre.

Laboratory designation	Specimen measurements, mm		Mass of specimen, g	Date of testing	Age of the specimens	Density, kg/m³	Crushing force, kN	Compressive strength, N/mm²	Average compressive strength, N/mm²	Breaking picture
	d	H								
4	141,7	118,0	4019	26.07	-	2160	210,0	13,3	13,4	R
5	141,9	132,6	4510			2151	223,5	14,1		R
6	142,1	142,1	4878			2165	200,9	12,7		R

*T-81 ja T-74188 intersection

The test results apply only to the tested samples

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METROSERT SERTIFITSEERITUD / CERTIFIED ISO 9001

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EN ISO/IEC 17025
L036

TEST REPORT
№ 2060/18

20.06.2018 № 7-6.4/2285
Page **1**/**1**

Client: Megatrade OÜ – Kaido Randalu

Description of job: Testing of stabilized soils

Samples:

Object Põltsamaa

Place of Sampling Põltsamaa

Date of taking samples and sampler
18.06.2018 ,
Raino Piirsalu, AS Teede Tehnokeskus

Date of delivering samples and deliverer
18.06.2018 ,
Raino Piirsalu, AS Teede Tehnokeskus

Clients marking of samples
-

Reg. Number in laboratory
2786

Testing and results

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Laboratory designation	Place of sampling	Specimen measurements, mm		Mass of specimen, g	Date of testing	Age of the specimens	Density, kg/m³	Crushing force, kN	Compressive strength, N/mm²	Average compressive strength, N/mm²	Breaking picture
		d	H								
2	~500 meters from intersection*	143,1	118,5	4397	20.06	-	2307	278,6	17,3	**15,1**	R
3	~900 meters from intersection*	143,0	118,2	4346			2293	231,4	15,7		R
4		143,2	118,7	4320			2260	201,1	14,5		R
6.1		143,2	118,6	4202			2200	191,6	12,9		R

*T-81 ja T-74188 intersection

The test results apply only to the tested samples

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