

NovoCrete[®]

Soil stabilization technology

NovoCrete[®]
soil stabilization technology
ahead of its time



Content

Initial situation

The solution

The result

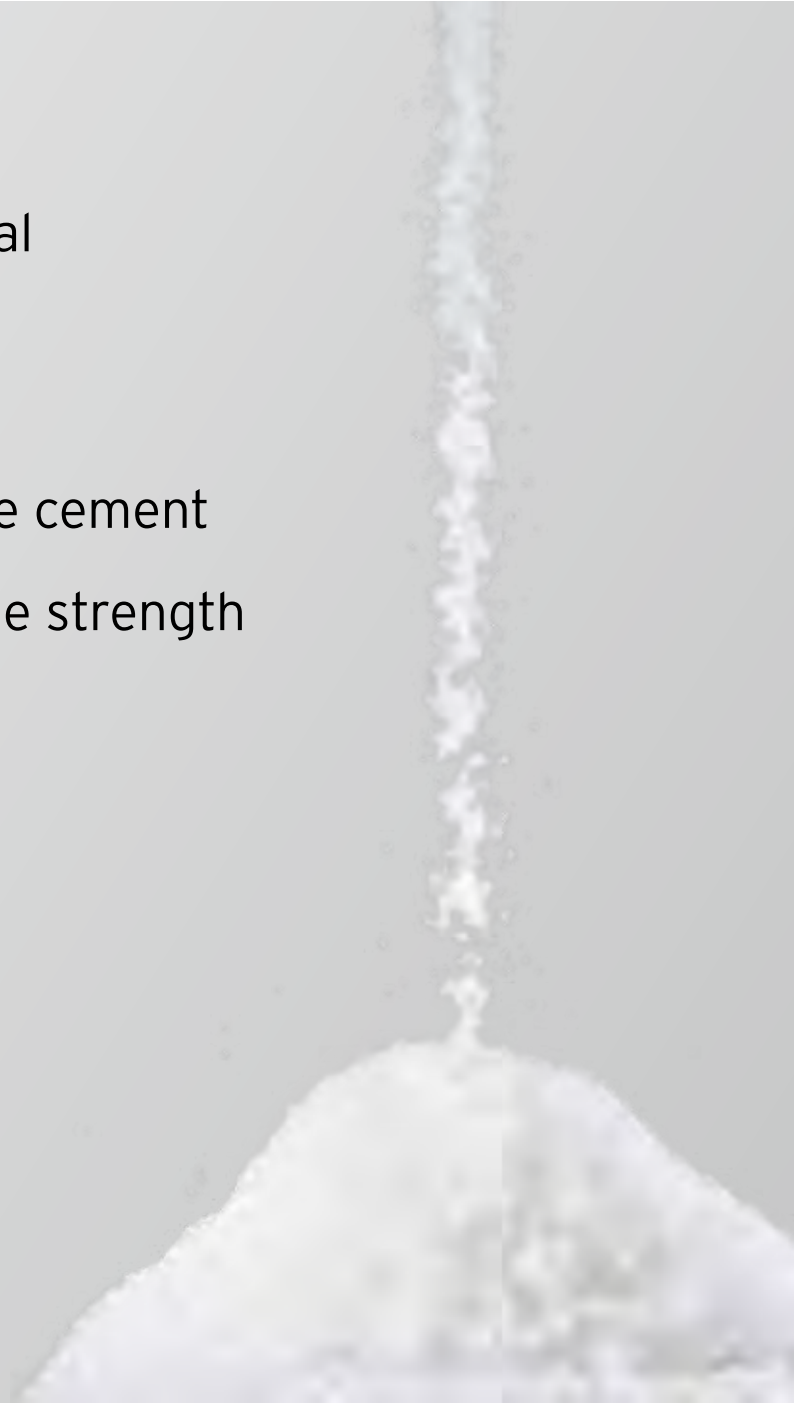
10 arguments for NovoCrete[®]

Typical damages when using conventional technology



The innovative NovoCrete® technology

- › NovoCrete® is a white powder made from 100 % mineral components
- › Manufactured in Germany
- › Used as an additive to traditional Portland or composite cement
- › Provides higher load bearing capacity and higher tensile strength as well as an improved modulus of elasticity
- › PH levels will be neutralized and water impermeable layers can be built
- › Non-toxic and not harmful to health
- › Recyclable up to 100 %

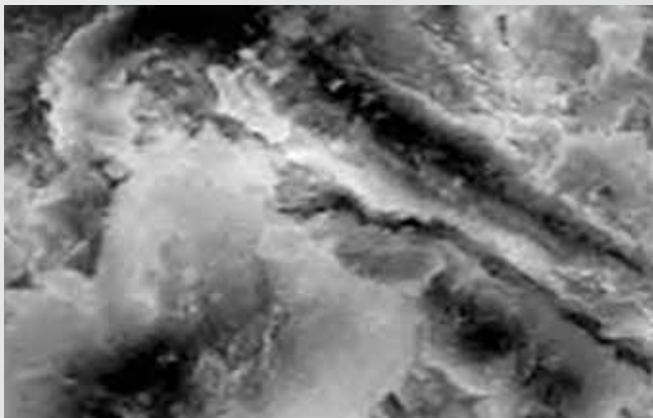


Effectiveness

NovoCrete® is added to cement with a share of 2% and mixed together with the in-situ soil material.

By adding water NovoCrete® increases the formation of crystalline structures during the cement hydration process.

*Untreated cement:
open pore structure*

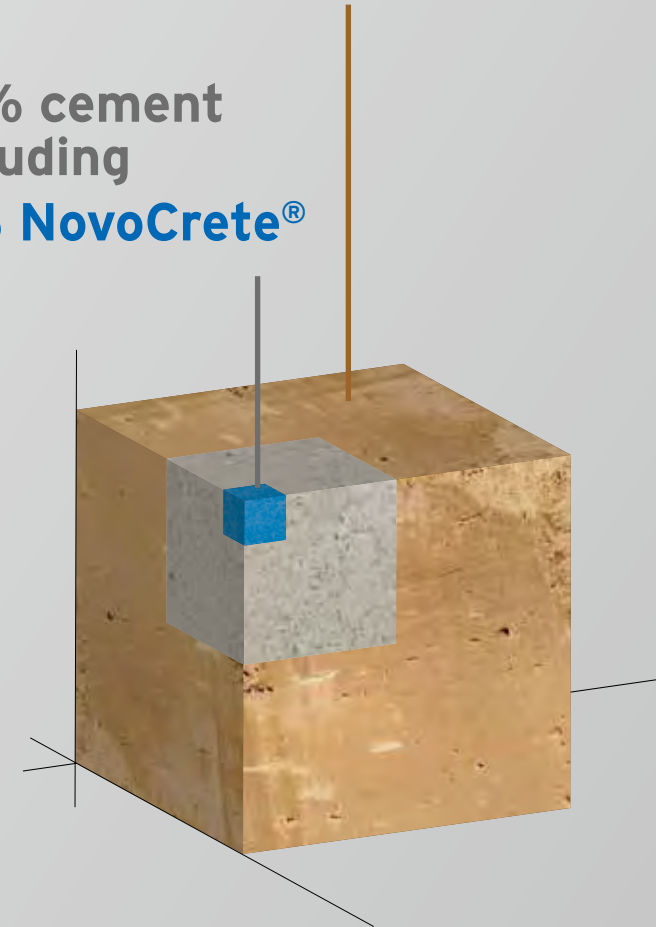


*Treated cement with NovoCrete®:
closed dense structure*



90% in-situ soil

**10% cement
including
2% NovoCrete®**



Perfect surface of the stabilized layer



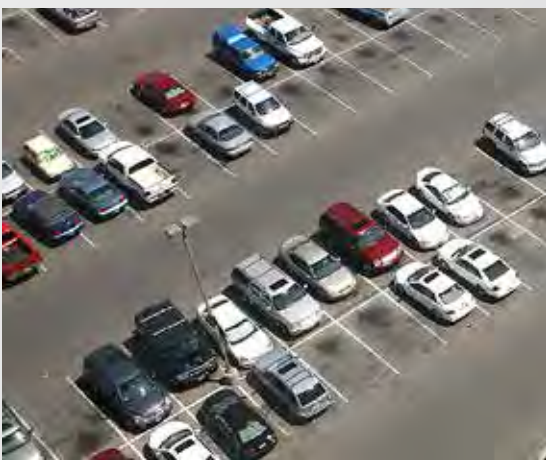
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Argument no. 1

Manifold areas of use

1. Broad Range of Applications



Streets and Lanes

- > road construction
- > motorway construction
- > footpaths
- > cycle paths
- > forest trails
- > agricultural roads
- > industrial access roads
- > verge stabilization
- > storage areas

Areas

- > installation of base courses underneath indoor surfaces
- > general foundation
- > car parks
- > container parking areas
- > logistics centres
- > harbour sites
- > wharves
- > storage areas for wood, metal etc.
- > bio-gas plants
- > silage storage areas
- > chaff storage
- > landfill sights

Special applications

- > railway tracks
- > tunnel and drainage system construction
- > slope stabilization
- > bank stabilization
- > slope reinforcement, grout
- > deep foundation replacement

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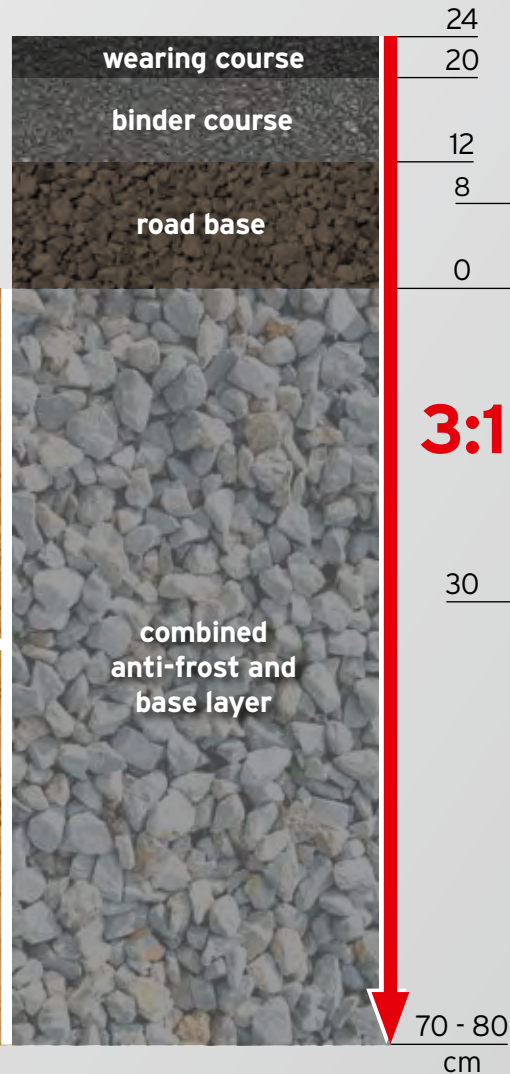
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Argument no. 2

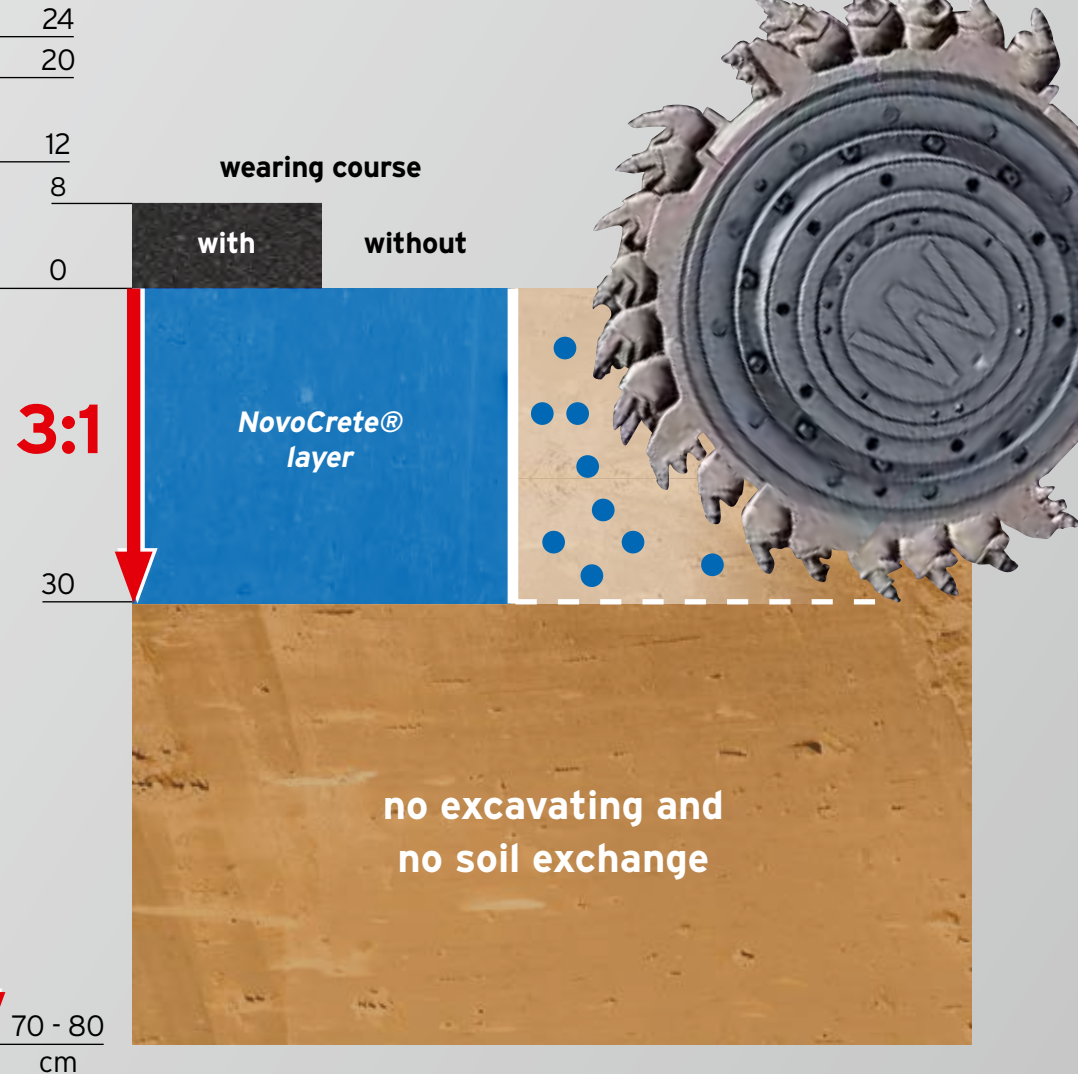
Possible savings

Conventional soil stabilization vs. NovoCrete® comparison

Conventional construction



NovoCrete® construction



Advantages at a glance

- › 90 day hydration process: next to no cracking with binder from up to 14%
- › During the hydration process, long crystal needles are formed, allowing very high bearing strengths
- › With a binder content of >10%, after 1 to 2 days values of at least 150 MN/m² can be attained, and can continue to increase for up to 90 days
- › The stabilized layers show low bending tensile strength.
Concrete anchors may be installed
- › Water does not penetrate, nor any other fluid, into the stabilized layers, guaranteeing safety from frost
- › Low clean up costs at accidents involving leaked noxious matter, as liquids remain on the surface (no absorption)
- › Longer lifespan as it is water-resistant, and increased acid and salt resistance

Advantages at a glance

- › Lifespan can be prolonged by laying a thin wearing course
- › No problems with loamy or clayey soils containing high levels of sulphur associated with high cement content
- › Grainy sands or organic material can be reinforced
- › Soils with high levels of salt can be stabilized
- › Stabilizing contaminated soils is possible
- › No problems from frost, thaw or changes in conditions, as water-resistant base courses may even be constructed from in-situ soils
- › Stabilization measures can be customised and adapted to particular soil conditions
- › Repair work can be significantly reduced
- › Restoration of surfaces to original condition is possible

Example calculation Ø costs*/m²

Layers	conventional	NovoCrete®
asphalt surface layer	4 cm = XXXX €	8 cm = XXXX €
binder course	8 cm = XXXX €	-
NovoCrete®-layer	-	30 cm = XXXX €
asphalt base course	12 cm = XXXX €	-
base and frost protection course	60 cm = XXXX €	-
total costs	XXXXXX €	XXXXXX €

*Costs always as a function of national / regional parameters

With or without top layer



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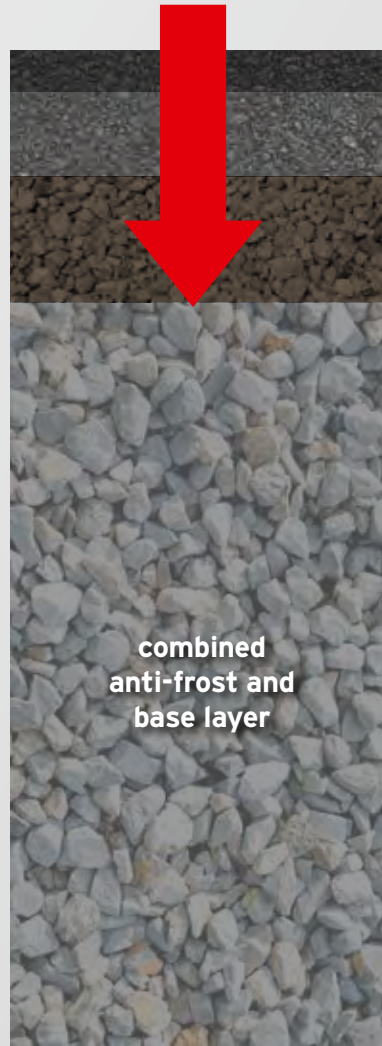
Argument no. 3

High Heavy Load Capacity

Compared

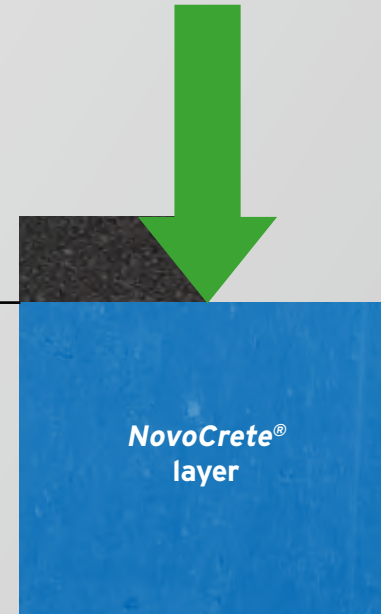
Conventional construction

max. 150 MN/m²

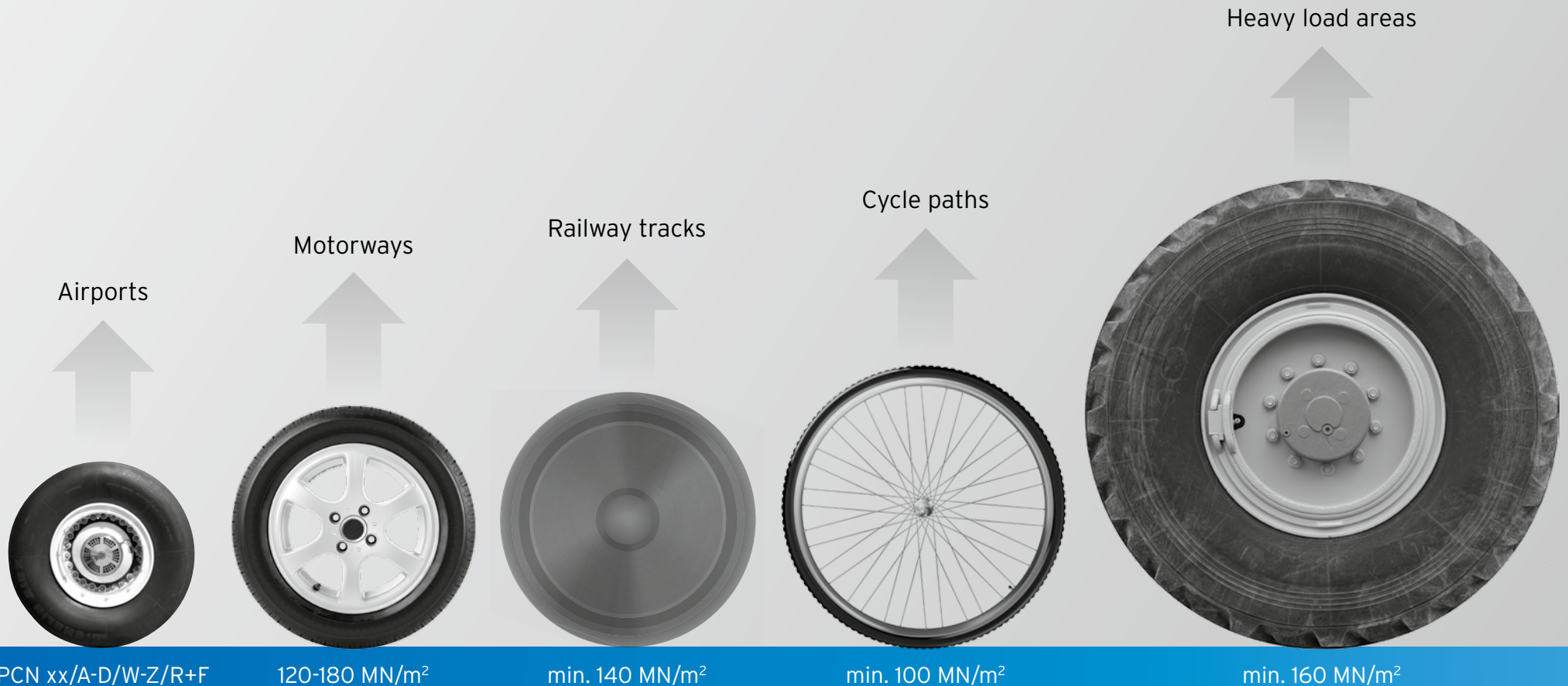


NovoCrete® construction

> 150 MN/m²



Minimum bearing capacity to achieve (dependent on the project)



3. High Heavy Load Capacity

> 60t



> 40t



> 100t



> 50t

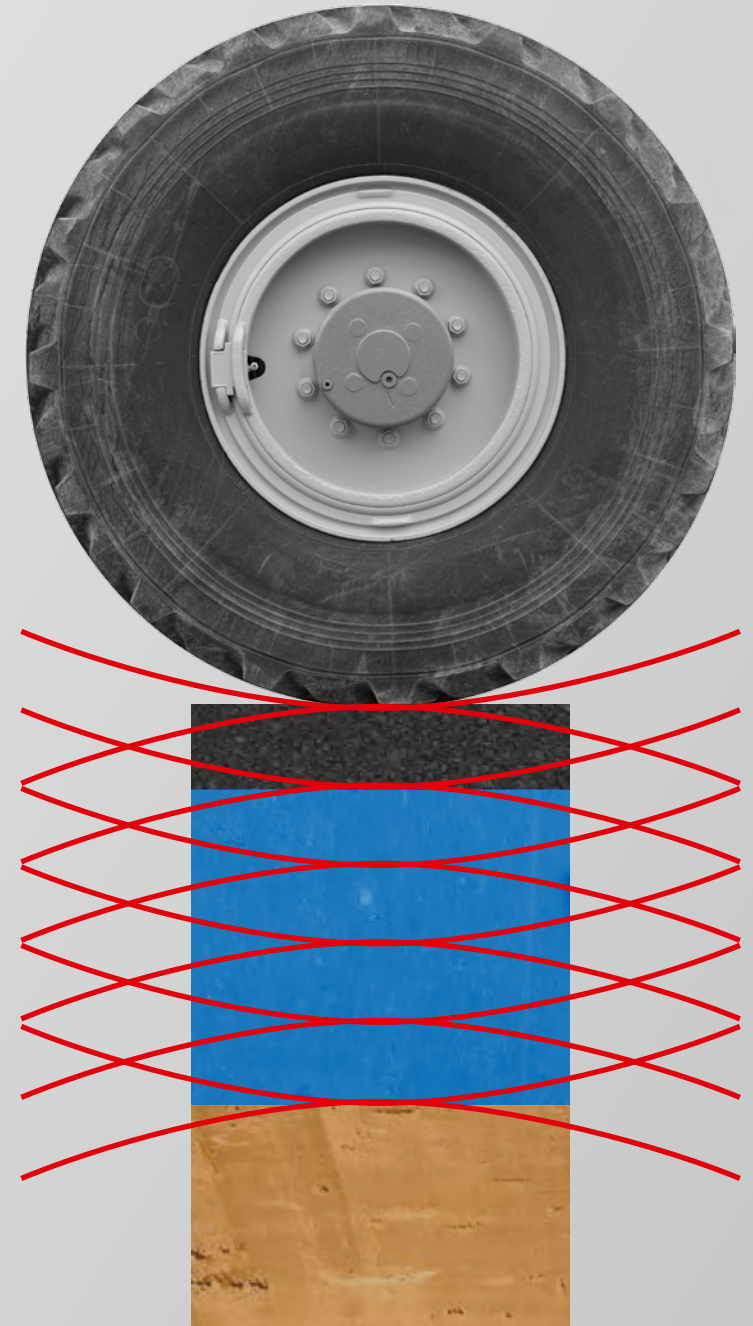


Erection of concrete elements directly on the NovoCrete® layer



High flexibility

The stabilized layers generate a very high tensile strength and a high flexibility which allows the absorption of vibrations e.g. caused by heavy truck traffic.



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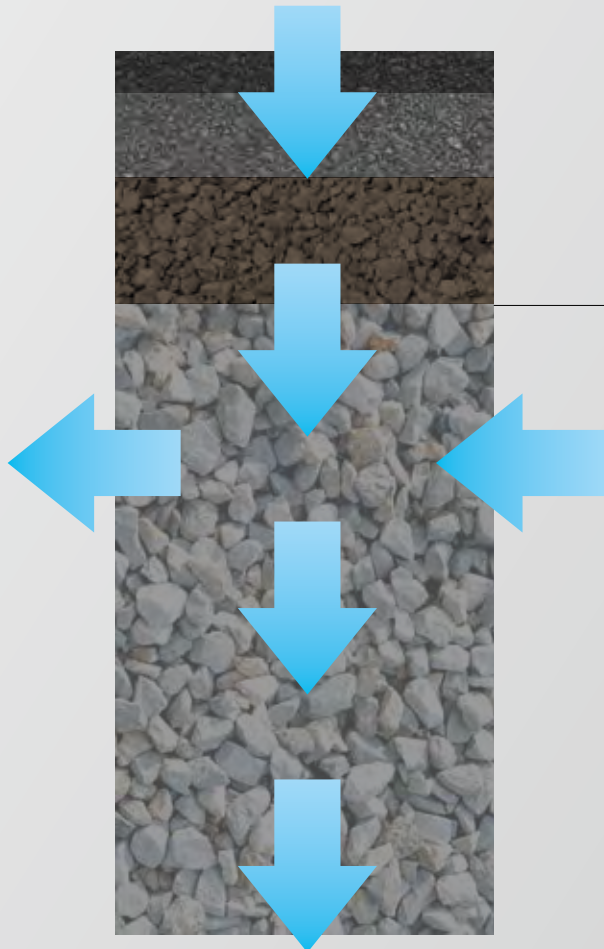
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Argument no. 4

Leak Proof Surfaces

Waterproof, increased acid and salt resistance

Conventional construction



NovoCrete® construction





STOP!

Water impermeability depending on soil type

Soil type	Amount of binding agent*	Milling depth	Water impermeability of the NovoCrete® layer
wide-graded gravel narrow-graded gravel intermittently-graded gravel wide-graded sand narrow-graded sand intermittently-graded sand	from 140 kg/m ³ to 180 kg/m ³	0,25 - 0,50 m	10 ⁻⁶ to 10 ⁻⁹ (m/s)
gravel-silt mixture gravel-clay mixture sand-silt mixture sand-clay mixture	from 170 kg/m ³ to 200 kg/m ³	0,30 - 0,50 m	10 ⁻⁶ to 10 ⁻⁹ (m/s) 10 ⁻⁷ to 10 ⁻⁹ (m/s)
slightly plastic clay slightly plastic silt medium plastic silt medium plastic clay highly plastic clay	from 180 kg/m ³ to 220 kg/m ³	0,30 - 0,50 m	10 ⁻⁸ to < 10 ⁻⁹ (m/s) < 10 ⁻⁹ (m/s)

The final amount of binding agent and the milling depth must be determined for every project in dependance of the traffic volume, the climatic conditions, and the results of respective suitability tests.

* Normally binding agent consists of 98 % standard cement + 2 % NovoCrete®

waterproof = frost protection = no potholes



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Argument no. 5

**Adaptable to
most soil types**

Adaptable to most soil types

- › Clayey, silty and sandy soils can be stabilized
- › Soils with a share of organic matter up to 15 % can be stabilized
- › Soils high in salt content can be stabilized
- › Suitable to stabilize and immobilize contaminated soils at the same time



Amount of binding agent depending on soil type

Soil type		Initial water content	Amount of binding agent *	Compressive strength N/mm ²
Non cohesive soils	wide-graded gravel narrow-graded gravel intermittently-graded gravel wide-graded sand narrow-graded sand intermittently-graded sand	from 0 to 10/15 %	from 140 kg/m ³ to 180 kg/m ³	7 days - 28 days from 3,0 to 9,0
Mixed grained soils	gravel-silt mixture gravel-clay mixture sand-silt mixture sand-clay mixture	from 0 to 15/30 %	from 170 kg/m ³ to 200 kg/m ³	7 days - 28 days from 2,5 to 6,5
Cohesive soils	slightly plastic clay slightly plastic silt medium plastic silt medium plastic clay highly plastic clay	from 0 to 30/35/45 %	from 180 kg/m ³ to 220 kg/m ³	7 days - 28 days to 2,0 to 4,5
Organic soils	Mould Organic clay Organic silt	In dependance of the results of respective suitability tests the NovoCrete® technology can be applied, maybe soil must be exchanged.		

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Argument no. 6

Certified quality

Digging, soil samples, suitability tests

- › Geological expertise
- › Suitability tests
- › Laboratory examinations
- › Construction site survey

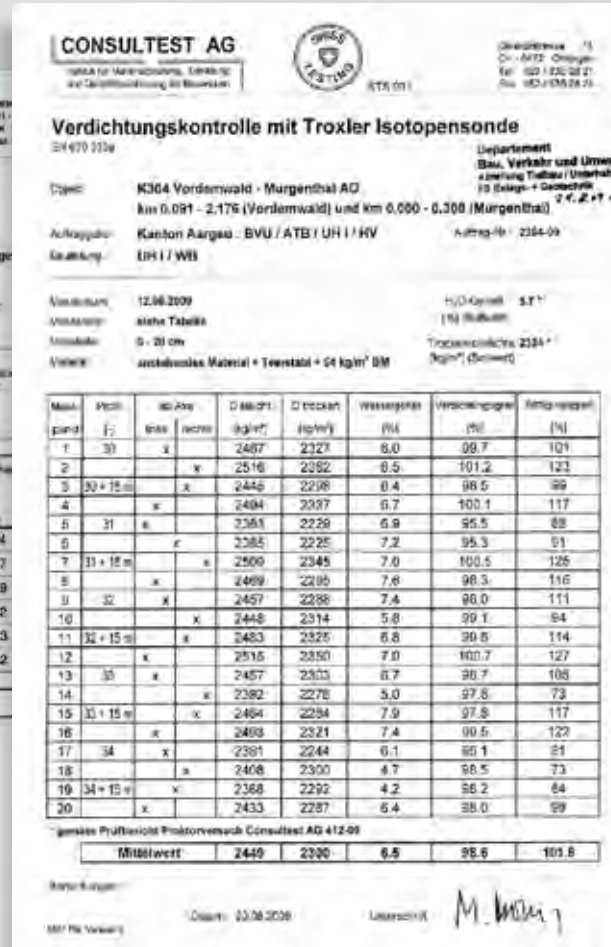
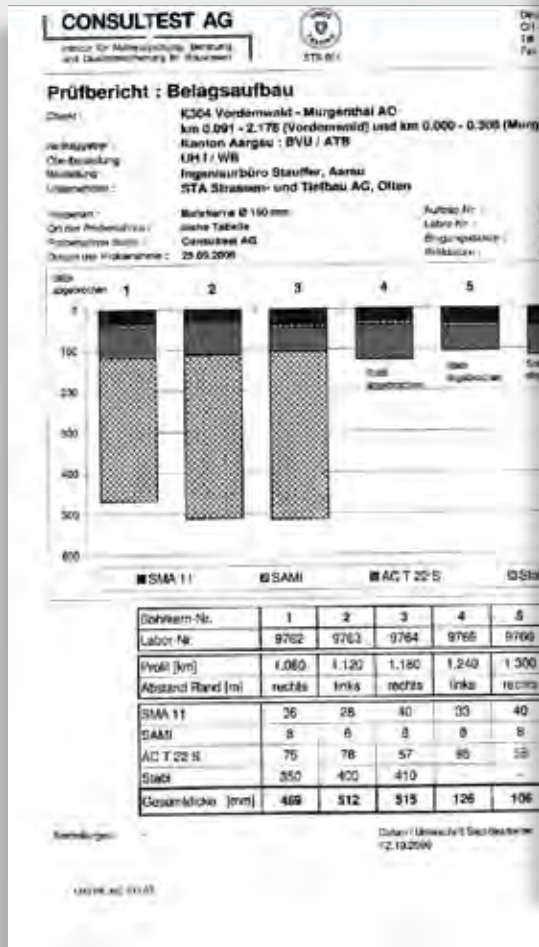


Quality assurance

- › Creation of specimen on the site
- › Execution of a dynamic falling weight drop test
- › Testing by using a Troxler sonde
- › Execution of a static load plate bearing test



Drill core analysis



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Argument no. 7

Sustainability

Virtually no maintenance

- › Solid base layer = longer life span of the road
- › No potholes to fill
- › Formation of cracks in the asphalt layer is decisively reduced



References on durability

Unterlunkhofen 2013, built 2006



Alikon 2013, built 2006



Vordemwald 2013, built 2007



Remigen 2013, built 2007



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Argument no. 8

Environment-friendliness

Advantages for the environment

- › No chemistry, only mineral components
- › Contaminated soils can be stabilized and immobilized in one procedure
- › Able to reclaim areas back to original state
- › No soil exchange material
- › No need for landfill sites
- › No gravel/aggregate material required
- › Less shipping volume and site-traffic
- › Without top layer it is possible to achieve an optical adjustment to the environment due to the similar color of the soil



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Argument no. 9

Simple Application

Procedure steps

- Preliminary work**
- › Milling of the old asphalt layer
 - › Breaking up of old asphalt layer by using a Grubber (optional)
 - › Mixing of asphalt/gravel material by using a stone crusher (optional)
-

- Stabilisation**
- › Spreading of binding agent by using a spreader vehicle
 - › Milling of cement-/NovoCrete® mixture
 - › Compaction with a steel drum roller (8 - 12 t)
 - › Preparation of the fine level by using a Grader
 - › Irrigation while milling and after compaction
-

- Top layer**
- › Fitting-in of the new asphalt layer after 24 hours

Milling of the old asphalt layer



Breaking the asphalt layer with a grubber (optional)



Crushing of asphalt/gravel material with a stone milling machine (optional)



Applying the binder with a spreader



Applying NovoCrete® with a mobile spreader



Milling of the cement/NovoCrete® mixture



Compression with a smooth drum roller (8-12t)



Creating the fine leveling with a grader



Watering while milling and after compression



Integration of the new asphalt layer already after 24 hours



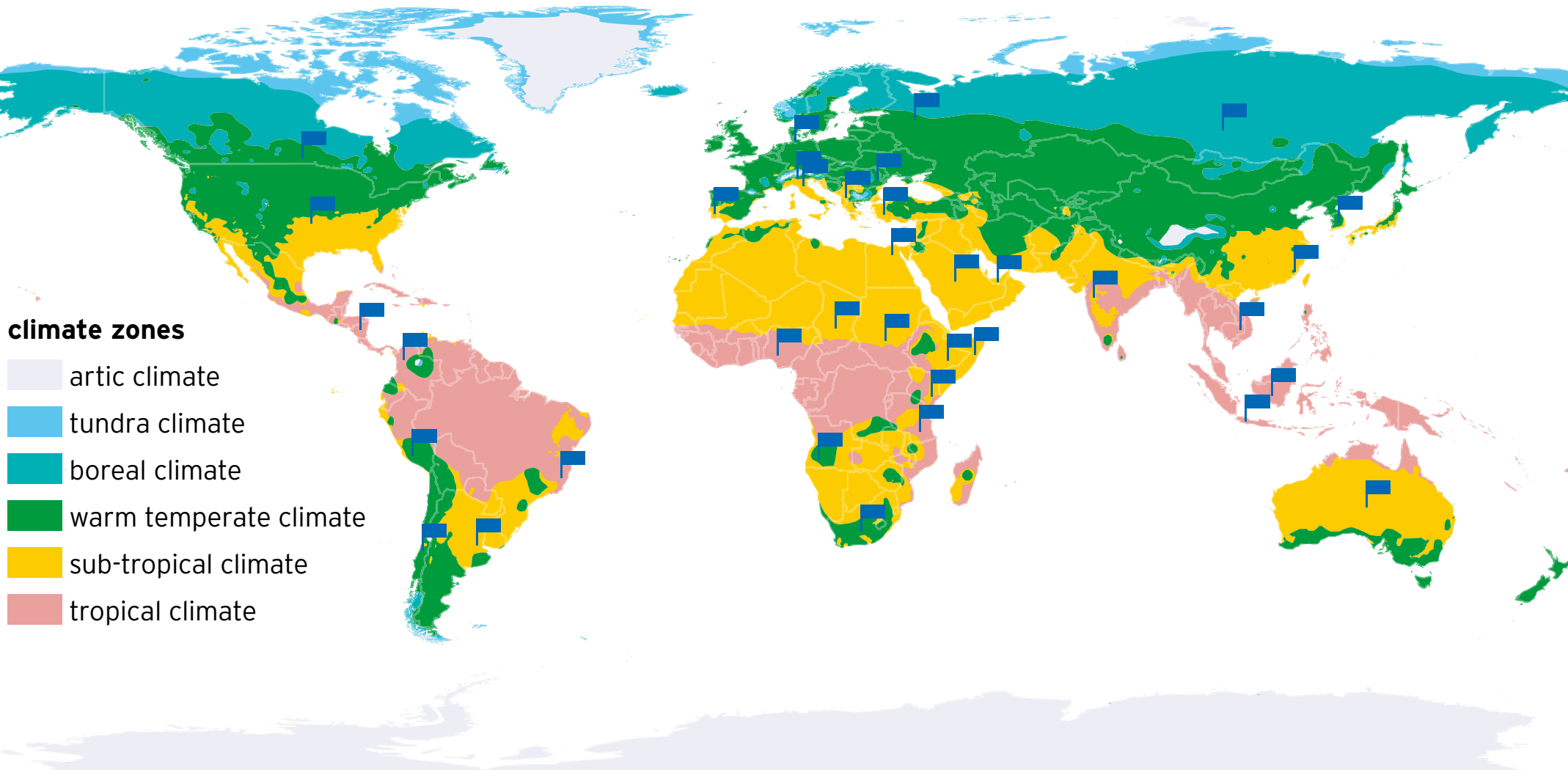
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Argument no. 10

Worldwide acceptance

NovoCrete® - usage worldwide



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**Thank you for
your attention!**

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OPiS AG

**AUTARK Energy & Infrastructure
Solutions GmbH & Co. KG**

Brienner Str. 9, D-80333 München, Germany,
Phone +49 (0) 89-290 97 286, Fax +49 (0) 89-290 97 446
www.autark-energy.com,
moormann@autark-energy.com

AUTARK
Energy & Infrastructure Solutions

