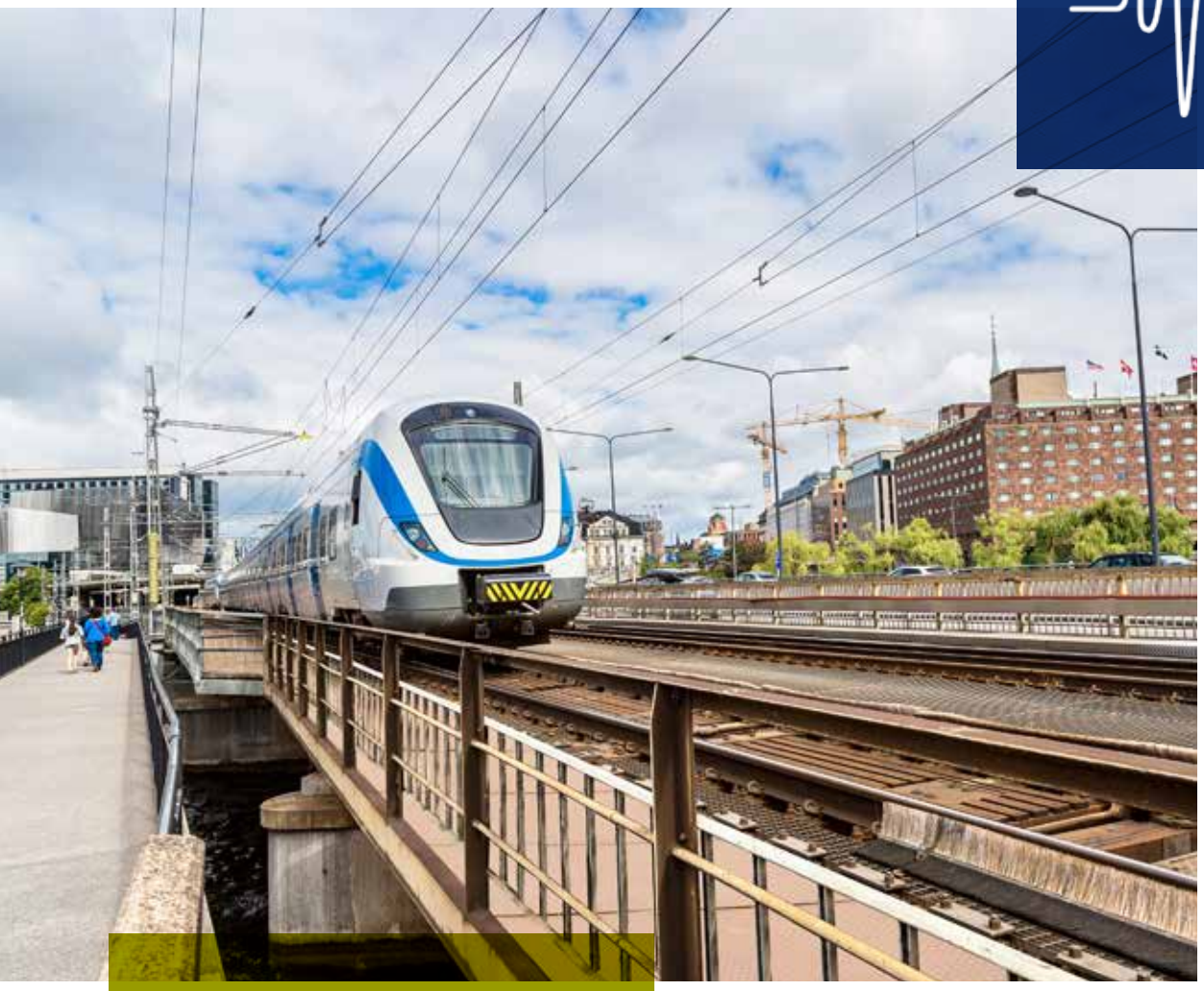
Lapinus®

Part of the ROCKWOOL Group

Rockdelta®

Vibration control solutions for
pleasant rail-side living conditions



Welcome to ROCKWOOL

Our purpose
Release the natural power of stone to enrich modern living

At the ROCKWOOL Group, we are committed to enriching the lives of everyone who comes into contact with our solutions.

Our expertise is perfectly suited to tackle many of today's biggest sustainability and development challenges, from energy consumption and noise pollution to fire resilience, water scarcity and flooding.

Our range of products reflects the diversity of the world's needs, supporting our stakeholders in reducing their own carbon footprint along the way.

Stone wool is a versatile material and forms the basis of all our businesses. With approx. 11,000 passionate colleagues in 39 countries, we are the world leader in stone wool solutions, from building insulation to acoustic ceilings, external cladding systems to horticultural solutions, engineered fibres for industrial use to insulation for the process industry and marine & offshore.

ROCKWOOL
Firesafe insulation for all types of buildings and installations

Lapinus
Engineered stone wool solutions for global industries

Grodan
Precision growing for the horticultural industry

Rockpanel
Exterior cladding for buildings

Rockfon
Acoustic ceiling and wall solutions

39
countries in which we operate

11,000
employees worldwide

45
manufacturing facilities

This is Lapinus

Lapinus is the world leader in precision-engineered stone wool solutions. We develop and supply versatile and innovative products that help global industries to improve quality of life.

Our products are used in a wide range of applications, including friction, water management, tracks, coatings, gaskets and fences.

With more than a quarter-century of expertise and experience, we work closely with customers to adapt to their ever-changing needs, from water management to fire safety, vibration isolation to noise and dust emission reduction.

Made from 100% stone, our sustainable products contribute to shaping a better world for today and tomorrow.

Lapinus is part of the ROCKWOOL Group.

Tracks
Vibration control solutions for pleasant rail-side living conditions

Friction
Innovative fibre solutions for safe and comfortable braking performance

Water management
Natural solutions for sustaining water resilience

Fences
Noise fences for quiet and peaceful living environment

Coatings
High performing stone fibres for durable and fire protective coatings

Gaskets
Thermal resistant stone fibres for high performance sealing solutions

Lapinus

Towards a more sustainable future

Release the natural power of stone to enrich modern living

At Lapinus, we are dedicated to providing solutions that will enable everybody to improve the future. Within the global industry we identify trends and challenges driving the development of tomorrow's products. Using our knowledge of stone wool we design solutions that have a positive impact on safety, emissions, noise, vibration, and water management, and will improve the quality of life. By developing and sharing our own knowledge and expertise we contribute to solving the challenges of our customers.

Our contribution to a sustainable future.

Ensure safety
All Lapinus products are made from natural stone and are biosoluble. They are safe for humans and the environment.

Reduce fine dust emissions
Friction formulations reducing wear of car brakes contribute to a reduction of fine dust emissions.

Control vibration
Rail tracks with reduced ground-borne vibrations have a positive influence on a comfortable living environment.

Reduce noise
Car brakes that produce less noise and fences that reduce ambient noise result in a healthier society.

Manage water
Water management systems that actively regulate water contribute to a resilient infrastructure and sustainable modern living.

Disseminate knowledge
We generate knowledge and share it with our stakeholders to help solve their challenges.

To address the global challenges, the UN has identified **17** UN **Sustainable** Development **Goals**:

As part of the ROCKWOOL Group, we actively contribute towards achieving **10** of the 17 goals.

Together with our group, we are **committed** to the **sustainable goals** by **2030**:

Health, Safety and Wellbeing:

- Driving a zero accident culture

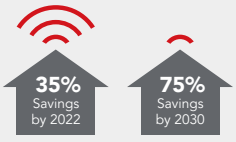
10% reduction in LTI per year **0** fatalities per year

CO_2 Emissions and Energy:

- Reduce CO_2 from factories (t CO_2/t Wool)

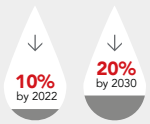
10% by 2022 **20%** by 2030

- Improve energy efficiency in own (non-renovated) building stock kWh/m²



Water Management:

- Reduce water consumption in factories (m³/t Wool)



Circular Economy:

- Increase the number of countries where we offer reclaiming of products from the market

15 countries by 2022 **30** countries by 2030

- Reduce landfill waste

Global trends and challenges

Increasing urbanisation

Worldwide there is a strong tendency for people to move from rural to urban environments. In cities and towns, they find better economic and social conditions compared to the rural areas. It is estimated that by 2050 almost 70% of the earth's population will live in cities. This brings about many infrastructural challenges. Many cities have already encountered the problem that important infrastructure projects – involving railways or tramways – come close to densely populated areas or vibration-sensitive areas.

Sustainable cities looking for sustainable solutions

Cities focus on providing a healthy and attractive living environment for their citizens. Therefore, they are increasingly searching for efficient, and sustainable green urban transportation systems. Offering significant advantages to individual users as well as to the community at large, the use of railways as rapid mass transportation systems in urban and sub-urban networks, is increasing worldwide. Ground-borne vibration caused by trams and train tracks can cause stress for people and may damage buildings.
There is a need for solutions to reduce ground-borne vibration from railway systems to provide healthy environmental conditions for people living near or on top of (underground) railways.

Rise to track vibration challenges

Scandinavia's preferred solution

In the early 1970s ground-borne vibrations due to railway traffic became an important environmental issue in Scandinavian countries. There was greater awareness of the harmful effects ground-borne vibrations had on people and buildings near rail tracks. Norwegian State Railways started testing various products to isolate ground-borne vibration, focusing on track-based counter measures.

ROCKWOOL stone wool mats quickly became the preferred solution in the Nordic countries. In the 1990s Rockdelta was introduced as the trademark for specially designed ROCKWOOL stone wool mats that tackle the problem of ground-borne vibration in a highly effective way.

Since 1974 Rockdelta stone wool mats installed under rail tracks have been proven efficient solutions worldwide.

Why reduce rail vibrations?

Rail induced vibrations and their harmful effects

Air-borne vibration v.s. ground-borne vibration
Rail traffic generates physical vibration. This mainly stems from contact between wheels and rails whose surfaces have a non-perfect geometry and from the passage of wheels and bogies over track joints and sleepers. This vibration is transmitted as ground-borne vibration or air-borne noise.

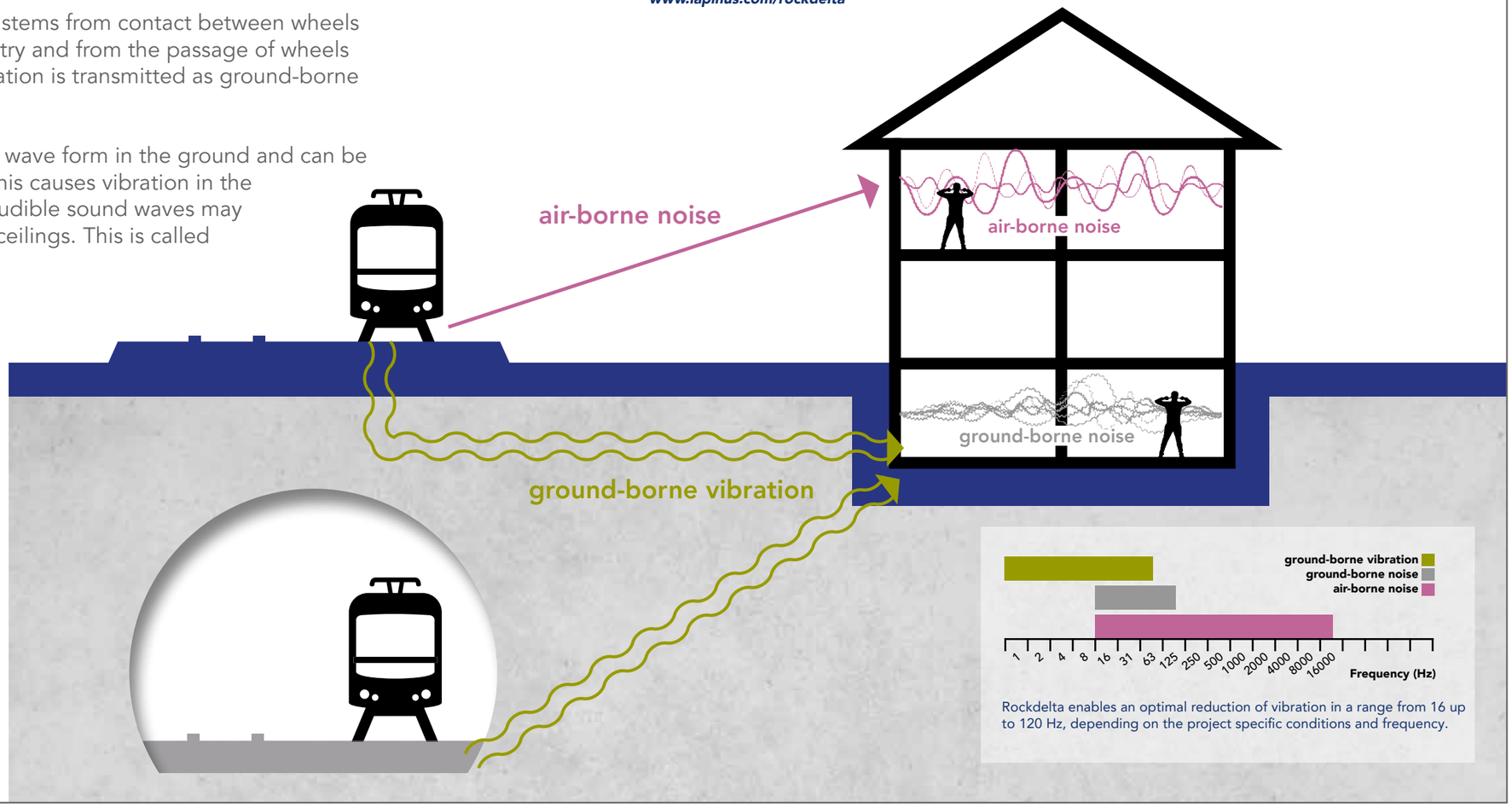
Ground-borne vibration and noise is propagated in wave form in the ground and can be transmitted into foundations of nearby buildings. This causes vibration in the building that can be felt by the people in it. Also, audible sound waves may be produced by resonance generated in walls and ceilings. This is called ground-borne noise.

The harmful effects of rail induced vibrations
In residential areas, the passage of rolling stock on railways or tramways, and the resulting generation of noise and vibration, may annoy the people living alongside the railways, causing everything from discomfort to an adverse impact on quality of life, often resulting in increased levels of stress during daytime and sleeping problems during night-time.

Ground-borne vibration is propagated in wave form in the ground and can be transmitted into foundations of nearby buildings. This causes vibration in the building that may cause damage to masonry and plaster. Historic buildings and delicate machinery in buildings near rail tracks are adversely affected by this kind of vibration.

Control ground-borne vibration and noise
Rockdelta vibration control mats are developed for attenuating ground-borne vibration and thus secondary air-borne noise induced by ground-borne vibration. In this way Rockdelta protects people and buildings. See more in this brochure or visit: ***www.lapinus.com/rockdelta***

Reduce air-borne noise
Noistop noise fences with stone wool cores are specially designed to reduce air-borne noise and ensure a comfortable living environment. See more at: ***www.lapinus.com/noistop***



Rockdelta enables an optimal reduction of vibration in a range from 16 up to 120 Hz, depending on the project specific conditions and frequency.

Who we are

Release the natural power of stone to tackle the increasing track vibration problems

Rockdelta stone wool mats are specialised in vibration control and structure protection for rail tracks. With more than 43 years of expertise, we utilise the unique natural properties of the most abundant resource, stone, to help overcome complex global transportation challenges and contribute to a quieter and more sustainable future.

What we do

Vibration control and structure protection

Vibration control:
Protecting people and buildings from harmful vibration

Rockdelta solves ground-borne vibration problems by isolating protected objects from ground-borne vibrations caused by rail transport systems: tramways, light rail systems, subways, metros, main lines and high-speed lines.

Attenuation of vibration is achieved by decoupling the track from the ground using Rockdelta as a resilient mat.

Structure protection:
Protecting subgrade and bridge deck by reducing ballast attrition

Rockdelta mats also protect the track superstructures against dynamic forces and extend the life of the ballast stones by reducing attrition, thereby enhancing overall ballasted track performance while significantly reducing the maintenance costs.

Why Rockdelta?

Thought Leader

- More than 80 years of experience in stone wool production
- More than 40 years of know-how in vibration control solutions

Sustainable

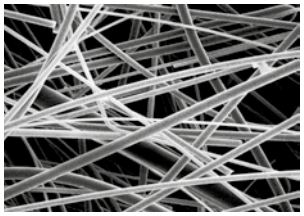
- Natural products made from stone
- Safe for humans and the environment
- Improve safety, comfort and well-being
- 100% recyclable, contribute to a circular economy

Reliable

- Since 1974, market leader in Nordics
- Proven technology in vibration control
- Business stability (part of the ROCKWOOL Group)
- Flexible and hassle-free logistics

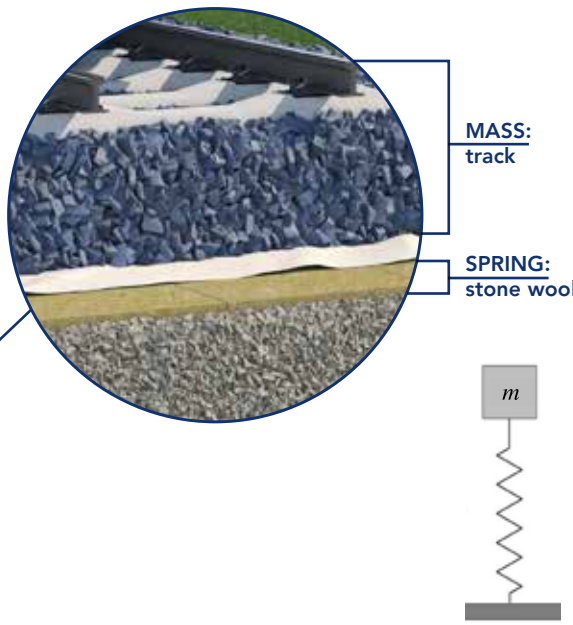
How stone wool works

Reducing vibration through spring-mass effect



Rockdelta full-contact resilient stone wool mats introduce a durable and high-efficiency spring element into the track structure.

Made up of billions of tiny interconnected fibres that act as beam elements, the mats are very strong and resilient. Stone wool mats bend when subjected to force input and then resume their original shape, effectively functioning as a spring. The spring effect decouples the dynamic behaviour of the track system effectively from the ground. This qualifies stone wool mats as very efficient vibration isolators.



Rockdelta applications

The natural solution for every track

Armed with unique material characteristics, including very low levels of material damping and unmatched, proven long-term functional performance, Rockdelta mats significantly aid the attenuation of ground-borne vibrations stemming from any type of track system. The vibrational forces are attenuated as they pass through the resilient support system.

The right choice

To determine the optimal mat parameters for each application the frequencies that must be addressed and the compliant stiffness of the mat must be calculated. Mats with different densities are tested and available. Based on knowledge and experience, our Rockdelta experts help you to choose the optimal solution for each situation in terms of vibration reduction and cost effectiveness.

Vibration control for ballasted tracks

High-performance, dual density Rockdelta mats with a composite geotextile top layer are the effective solution for resiliently supported ballasted tracks.

The dual density mats consist of a high-density force-distributing top layer and a low-density soft, resilient bottom layer.
The top layer also provides even and equal stiffness throughout the entire width of the track and distributes force from the rail structure evenly.

The high-density top layer protects the mats from potential impairment by the ballast stones, preventing the stone wool fibre material from deteriorating due to the static and dynamic loads from gravel, stone, soil and other covering materials.
The low-density resilient bottom layer provides optimal spring-mass effect. Also, it enables installation on surfaces that are not completely evened. The functionality of the mat is not affected by punctures.
The geotextile layer on top with high resistance to stretching and tearing enables easy maintenance of the ballast.

This geotextile is a high-quality composite product, comprising two membranes of non-woven geotextile and a load-distributing core.

Vibration control for slab tracks

The Rockdelta solution for any type of floating slab track system consists of a full-contact single-density mat that decouples the concrete slab track from the ground. The resilient stone wool-based support system introduces a durable and high-efficiency spring element into the track structure. By separating the dynamic behaviour of the concrete slab and the track system from the ground, vibrational forces are attenuated as they pass through the resilient support system.

The mats provide for the attenuation of ground-borne vibrations stemming from any type of floating slab track system. The unique material characteristics include very low levels of material damping and unmatched, proven long-term functional performance.
With ultra-low sensitivity to weather conditions (rain, temperature changes) Rockdelta mats exhibit outstanding efficiency and durability even after decades of operation under harsh climatic conditions.

Structure protection for all track types

Rockdelta offers superior sub-grade and bridge deck protection. The Rockdelta solution for structure protection (i.e. bridges, viaducts, etc.) is a single density, force-distributing stone wool mat with unmatched dynamic properties with inherent, first-rate volume compressibility.

Rockdelta mats also protect the track superstructures against dynamic forces and extend the life of the ballast stones by reducing attrition, thereby enhancing overall ballasted track performance while significantly reducing maintenance costs.

The exceptionally strong mats have a geotextile top layer with strong resistance to stretching and tearing. The mats are lightweight and have no significant influence on the total weight of the superstructure they are installed on.

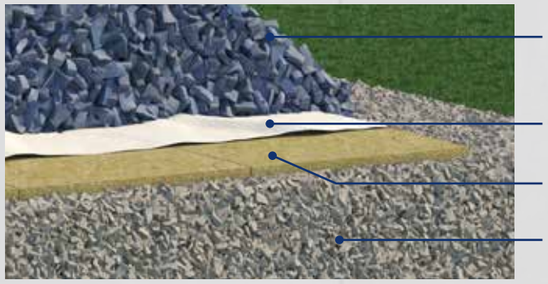
Rockdelta applications

The natural solution for every track

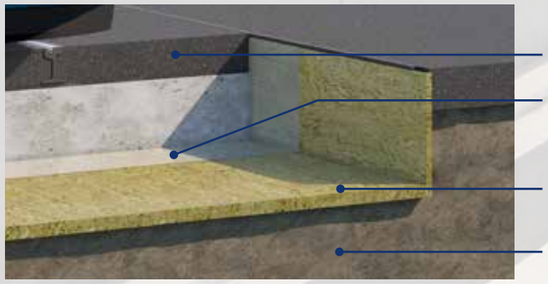
Rockdelta mats are designed, tested and manufactured to have an extended lifetime with retained functional performance even under extreme conditions.

This helps ensure the exceptional long product life cycle of Rockdelta mats.

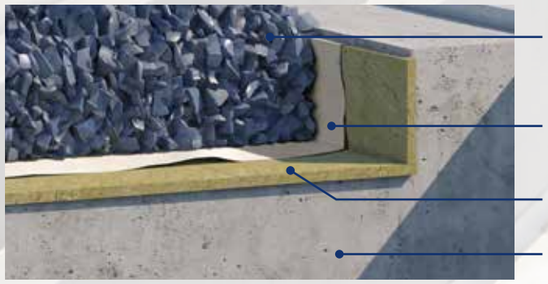
Vibration control for ballasted tracks



Vibration control for slab tracks



Structure protection for all track types



Metro de Lima L1, Peru

The power of stone wool

Versatile by nature

HIGH PERFORMANCE
SUSTAINABLE TECHNOLOGY

Vibro-acoustic capabilities
Reduce vibration and noise

Robustness
Stable performance under any condition

Thermal properties
Insulation against frost heave and heat load

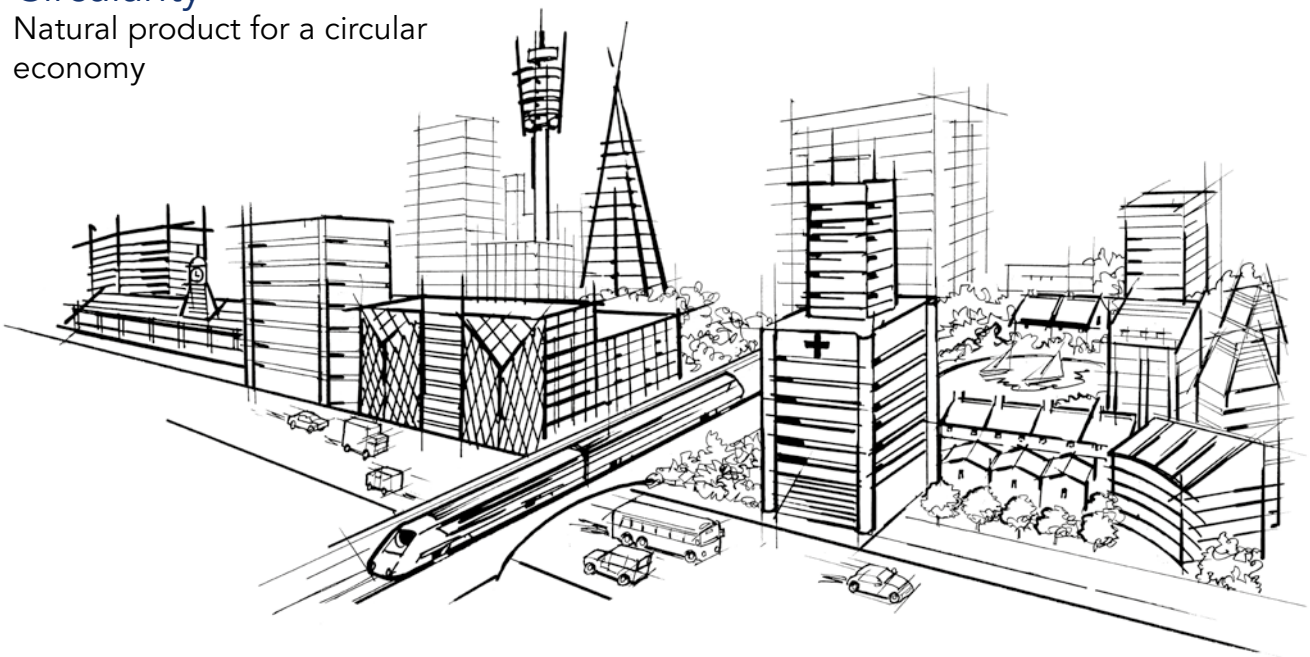
Circularity
Natural product for a circular economy

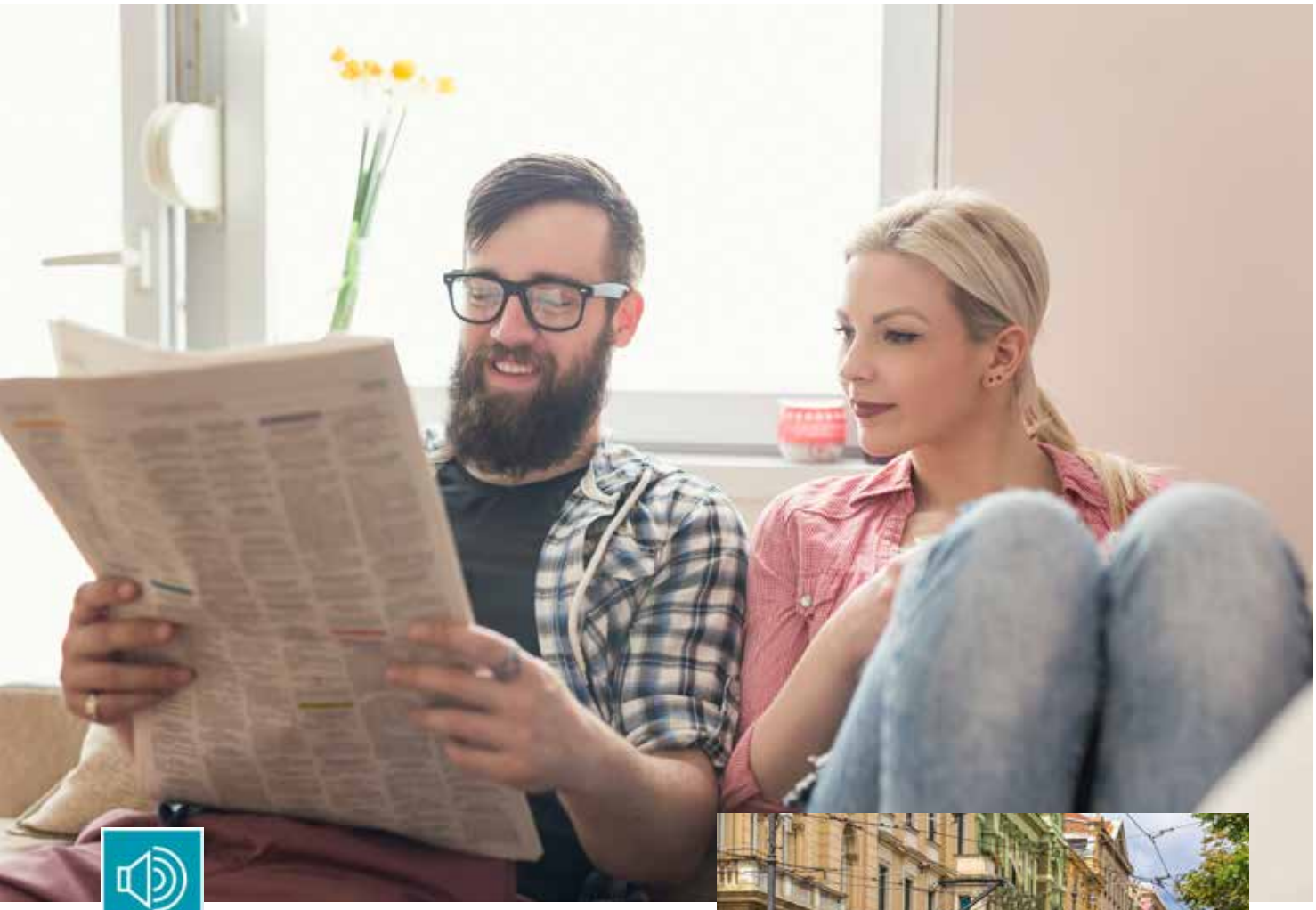
PROJECT EFFICIENCY
WITH LOW PROJECT COST

Efficient installation
Fast, easy, cost-effective

Simple storage
Can be stored indoors or outdoors

Fire safety
Fire safe construction environment





The power of stone wool
Vibro-acoustic capabilities

The vibro-acoustic capabilities of Rockdelta stone wool mats are used to protect people and buildings near tracks against ground-borne vibrations and noise.

These Rockdelta properties originate in the fibre structure of the mats. The millions of intricately interconnected fibres form an exceptionally strong resilient structure that isolates the energy of the vibration wave caused by passing trains.

Depending on the frequency and the track conditions, the spring-mass effect of our mats allows for vibration attenuation of up to 40 dB.*

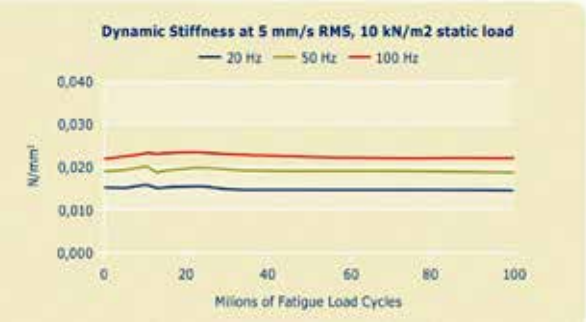
We can help you find the optimal solution to reduce the maximum amount of vibration.

**The vibration attenuation that can be achieved in a project depends on the specific rail track components (rail, ballast, fastening, sleeper) and the sensitive frequency range. For more information or a calculation for a specific project please contact us at info@lapinus.com.*

The power of stonewool
Robustness

Weatherproof Rockdelta stone wool mats guarantee a long operational lifetime because of their superior mechanical and chemical resilience.

Mechanical resilience:
Extensive testing of Rockdelta products have proved their outstanding fatigue resistance. The dimensional and mechanical properties remained unchanged after a series of demanding tests, ensuring predictable long-lasting functional performance of the applications. Both dynamic and static stiffness remain virtually unaltered, even after decades of use.



Fatigue testing
The dynamic or fatigue test can be used to calculate a real-life estimation. One cycle equals the passage of one axle of a wagon. The number of axles per train per hour divided by the millions of cycles determines the lifetime of the mats.

Weather-proof
Ambient temperatures – both high and low – can significantly influence the resilient components of rail tracks. Rockdelta mats show ultra-low sensitivity to weather conditions like rain, frost and extreme heat. Laboratory and in situ testing conclude that Rockdelta mats retain their vibration mitigation performance regardless of sub-zero or high temperatures.

Chemical resistance
Being made of stone wool, Rockdelta mats offer exceptional chemical resistance and are not impacted by ozone, acids, alkaline, oil, grease and corrosion.

Did you know?
As early as 1978, Norwegian National railways (NSB) after extensive research determined the best possible method for vibration isolation was to use anti-vibration stone wool mats. They installed the mats in a section of a tunnel track in the capital city of Oslo, right beneath the cathedral. Now, over 40 YEARS later these mats still perform to the same standards as the day they were instiled.

The power of stonewool
Thermal properties

In environments with extreme weather conditions Rockdelta mats function not only as an anti-vibration application but also provide the advantages of thermal insulation properties that stone wool is known for.

Rockdelta mats derive their unmatched thermal properties from tiny pockets of air trapped within the physical structure of the stone wool.

This benefit limits the influence of frost heave on rail tracks. The track geometry is thus secured for the entire lifetime of the Rockdelta mats, significantly reducing the cost of maintenance.

The power of stone wool
Circularity

Rockdelta mats are made from ROCKWOOL stone wool. This stone wool is a natural material, safe for humans and the environment. It is formed from one of the earth's most abundant materials – volcanic rock of over 200 million years old.

In a circular economy, products should be used for as long as possible – and reused to the greatest extent possible when they reach the end of their service life.

Our long-lasting Rockdelta mats are **100% RECYCLABLE**. Stone wool can be recycled again and again, engineered into new stone wool, contributing to a circular economy.

The power of stone wool
Efficient installation

Installing Rockdelta stone wool mats is very easy and fast, since the mats are easy to cut and easy to handle. The ease of installation guarantees an optimal construction process, unhindered by weather conditions.

Simplified formation levelling; no risk of punctures
No special preparation of the substructure is required. The mats have a considerable tolerance for – and can be installed on – surfaces that are not completely even. Small sharp objects or stones left underneath the mats have no influence on the functional performance.

Lightweight; easy to handle, no specialised workers required
The lightweight mats can easily be handled by one person, even under difficult circumstances on site. Manpower and time required for the installation is always minimal, even for a curved track.

Easy to cut
Cuts for special dimensions, pipes, drainage holes are easily done on-site with standard hand tools (i.e. jig-saw). Edges do not need to be protected. Manpower and time required for the installation is always minimal.

Can be installed under any weather conditions
Rockdelta mats can be installed under almost all weather conditions, including frost periods, which enables the smooth planning of the installation process with no extra costs due to unexpected changes or delays.

We offer support and assistance during all stages of the project, from calculation and prediction model until the installation is finished.

The power of stone wool
Simple storage

Rockdelta offers easy storage. The stone wool mats are lightweight and insensitive to ambient temperature and UV. Mats are delivered on pallets and can be stored outdoor regardless of weather conditions.

Rockdelta fire-safe stone wool mats can be stored near the installation site indoors inside tunnels or close to buildings.

Your storage can be kept at a minimum with our just-in-time delivery service if requested.

The power of stone wool
Fire safety

Rockdelta mats are safe to be stored, installed and used in environments where welding and other heat, fire and spark producing activities take place.

Rockdelta stone wool mats are non-combustible and are capable of withstanding temperatures of up to 1000°C without burning or melting, which is well above heat levels of typical house fires.

With minimal organic content the anti-vibration mats won't burn or release toxic gases or smoke when exposed to extreme heat.

Minimise overall project costs with Rockdelta

Minimise overall project costs with Rockdelta

At Rockdelta we help project owners with calculations and prediction models, using advanced digital tools and sophisticated algorithms.

Working with Rockdelta mats has proven to be the cost-effective solution for reducing ground-borne vibration in rail track structures.

While budgeting a project, not only the price per m^2 of the chosen solution must be considered. Taking into account the total project costs, including levelling, installation, adaptations, handling, cutting and connectors the choice for Rockdelta mats is the most economic one.

Certified solutions

Your reliable partner

All Rockdelta products are produced to the highest standards

- Tested according to DIN 45673 by accredited institutes
- Production process according to the highest standards
  - ISO 9001 and ISO 14001 compliant
  - CEN standards EN 13162 and EN 13172
- Health and safety: chemical fibre composition controlled by EUCEB

Rockdelta solutions have been tested and evaluated at European top institutes, laboratories and consulting engineering groups:

- **Brekke & Strand Akustikk as, Norway**
- **Danish Technical University, Denmark**
- **EMPA, Switzerland**
- **Ingemansson, Sweden**
- **KM Akustikbyrån, Sweden**
- **Müller-BBM, Germany**
- **Norwegian Building Research Institute, Norway**
- **Technical University of Munich, Germany**
- **TGM Vienna, Austria**

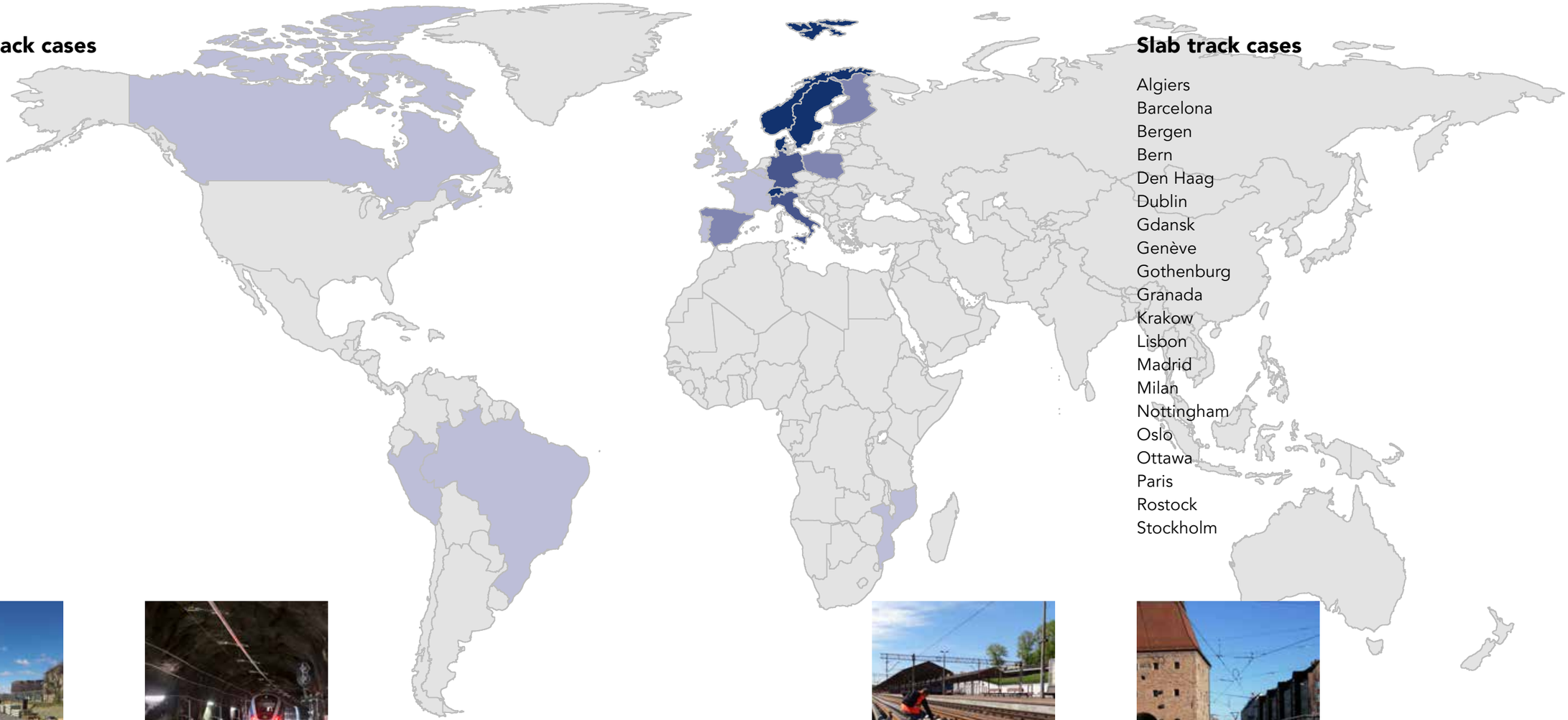
Who we work with

Selected cutomers

EMA, Algeria
Infrabel, Belgium
CPTM, Brazil
Ottawa council-OLRT, Canada
Banedanmark, Denmark
Copenhagen Metro , Denmark
The Finnish Transport Agency, Finland
RATP, France
Bordeaux Metropole, France
Freiburger Verkehrs AG, Germany
Rostocker Strassenbahn AG, Germany
Luas, Ireland
Metro Milan, Italy
RFI, Italy
CFM, Mozambique
Prorail , Netherlands
Haagsche Tramway Maatschappij, Netherlands
Trondheim Tram , Norway
Oslo Sporveien , Norway
AATE Lima, Peru
PKP PLK, Poland
ZIKiT Krakow, Poland
Metro Sul do Tejo, Portugal
REFER , Portugal
Metro de Madrid, Spain
ADIF, Spain
Trafikverket , Sweden
SL, Sweden
Bernmobil, Switzerland
Transport Publique Genèvois, Switzerland
NET Nottingham, UK

Our track record

Selected cases and references



Ballasted track cases

Aalborg
Barcelona
Basel
Bergen
Copenhagen
Gdansk
Hanover
Helsinki
Brussels
Karlsruhe
Lima
Lund
Lyon
Milan
Nottingham
Oslo
Ottawa
Stockholm
Warsaw

Slab track cases

Algiers
Barcelona
Bergen
Bern
Den Haag
Dublin
Gdansk
Genève
Gothenburg
Granada
Krakow
Lisbon
Madrid
Milan
Nottingham
Oslo
Ottawa
Paris
Rostock
Stockholm

Ottawa Confederation

Citybanen Stockholm

Askerbanen Skøyen Oslo

Malaga High Speed

Gdansk SKM Line

Rostock Tram

Bern Tram

The Hague Tram

Services and tools

Rockdelta offers outstanding customer support in all phases of the process, from preliminary design, impact assessments and prediction models to on-site installation supervision and l ogistic services.

Vibro-acoustic solution expertise

“We provide you vibro-acoustic expertise support based on your requirements”

- Acoustic knowledge sharing and training
- Calculations and mathematical model simulations
  IGITUR Program (Tailor made IL& Zimmermann calculations)
- High professional level of documentation

Optimum project integration

“We support you in integrating the optimum resilient solutions into your specific project”

- We provide project-based specification data
- Certificates according to local legislation and regulations
- Efficient communication with different project stakeholders

One point of contact

“One single and easy entry point for all your project needs”

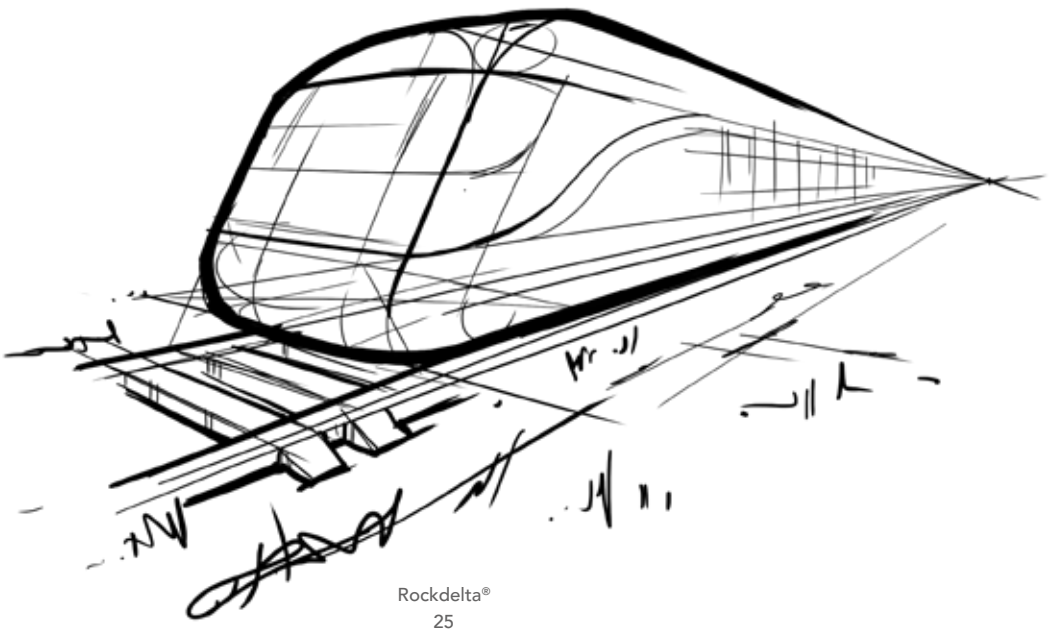
Backed up by a dedicated project team

- Technical
- Sales
- Logistics
- Installation

Installation follow-up

“We support you and your project from start to finish”

- Professional guidance, training & supervision during installation process
- Support during logistic process



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