INNOVATIVE SKYWAY TRANSPORT AND INFRASTRUCTURE TECHNOLOGIES

SKYWAY PHILOSOPHY

Transport should be a solution to problems, not their source. The SkyWay system provides passenger and cargo transportation in a separate space – on the 'second level' above the ground.

The fact that SkyWay vehicles move above the ground on a specially designed rail-string overpass ensures a number of advantages: optimized aerodynamics, increased speed, unprecedented safety, rational use of land and resources, minimized environmental damage caused by transport. In addition, the cost of construction and operation is significantly lower compared to the existing transport solutions.

ANATOLI YUNITSKI:

"THE SKYWAY TRANSPORT SYSTEM IS OPTIMAL, EFFECTIVE AND SAFE"

General designer of the innovative SkyWay technology and string transport Anatoli Yunitski is a scientist and inventor, the author of over 200 scientific papers, 18 monographs and more than 150 inventions in the spheres of construction, transport, machine-building, electronics and chemical industries.

The creator of SkyWay and geocosmic transportation systems, as well as a range of transport and infrastructure projects based on string technologies. The leader of two UN projects, the member of the USSR Federation of Cosmonautics.

President of the SkyWay Group of Companies. General designer of SkyWay Technologies Co.

SkyWay – the concept of an elevated transport system that has no analogues in the world.

Main elements of SkyWay transport and infrastructure complex:

- uncut pre-stressed rail-string overpass;
- rail automobiles on steel wheels characterized by highly aerodynamic design, equipped with an anti-derailment system and a smart system of safety, control, power supply and communications.

The development of SkyWay transport and infrastructure complexes is carried out by a team of engineers and designers of SkyWay Technologies Co. (Belarus).

SKYWAY TECHNOLOGIES CO.EMPLOYEES –

A TEAM OF LIKE-MINDED PEOPLE

COMPANY STRUCTURE

- Rolling stock department
- Automated systems department
- Department for elevated and infrastructure facilities
- Project management department
- Business development department
- Special design and technological bureau with pilot production
- EcoTechnoPark
- Advanced development department
- Department for technical inspection and quality control
- Department for standardization, certification and test management
- Chief Engineer's Office
- Legal department
- 15 design bureaus (over 200 design engineers)
- Design and architecture centre

SKYWAY
MANUFACTURING FACILITY

Special design and technological bureau with 'Unibus' pilot production carries out the whole range of works for SkyWay rolling stock manufacture:

- production of accessories, devices and components;
- testing of mechanical units and electronics;
- industrial prototypes testing.

The manufacturing facility serves to work out the most responsible and important technological solutions, the main SkyWay know-how.

MAIN TRANSPORT SOLUTIONS

The SkyWay systems can meet a wide range of transportation demands offering a possibility of highly efficient passenger and cargo transportation for any distances under any natural and climatic conditions.

SkyWay – speed, safety, comfort, affordability, cost effectiveness, sustainability.

SkyWay – increased social activities for people.

SkyWay – the basis for the information, power, transport and communications network of a new generation.

All types of SkyWay systems are distinguished by energy efficiency, minimal adverse environmental impact and a high safety level of passenger and cargo transportation.

URBAN TRANSPORT

Designed for short distance passenger transportation (up to 200 km).

It fits harmoniously into the existing infrastructure of any megalopolis.

It solves transport problems of large cities by developing a network of high-rise buildings connected with each other by elevated (air) transportation.

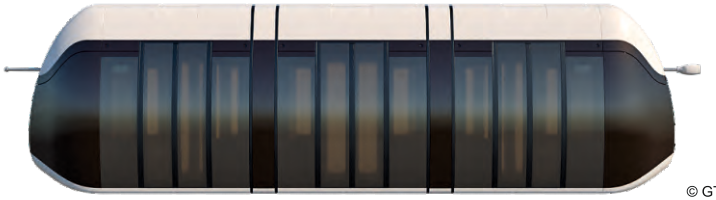
UNIBUS AND UNICAR

MODEL RANGE:

- Large class double-rail unibus
  (passenger capacity: 7–28 people;
  in articulated vehicles – up to 84–168)

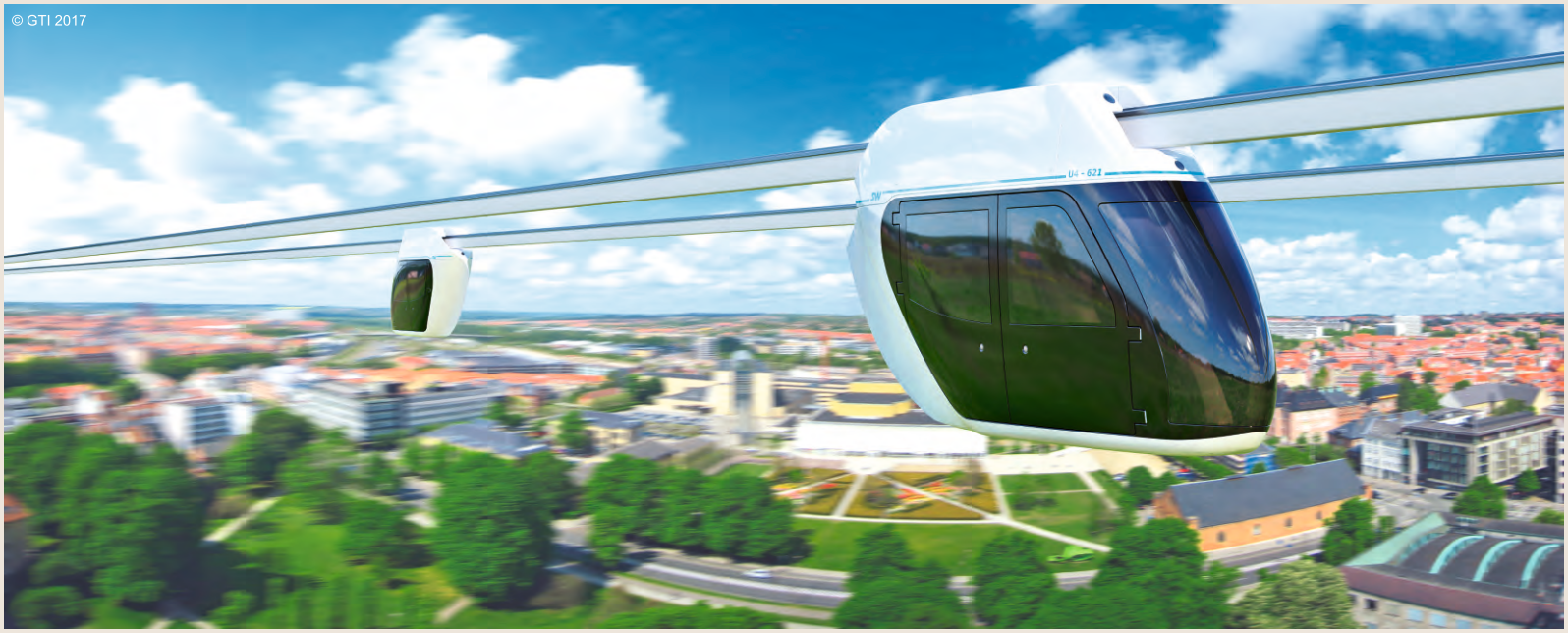
- Middle class monorail unibus
  (passenger capacity: 3–14 people;
  in articulated vehicles – up to 84)

- Small class monorail unicar
  (passenger capacity: 2–6 people;
  in articulated vehicles – up to 6–18)



Maximum speed: 120–150 km/h.
Performance: up to 50,000 passengers/hour and more.
Maximum longitudinal slope of the track: 30 %.

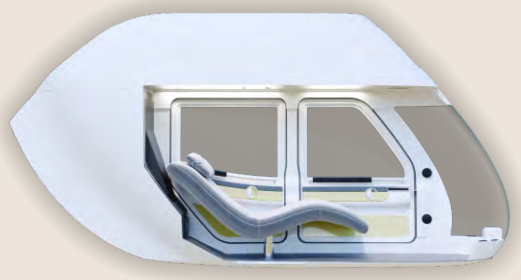
UNIBIKE

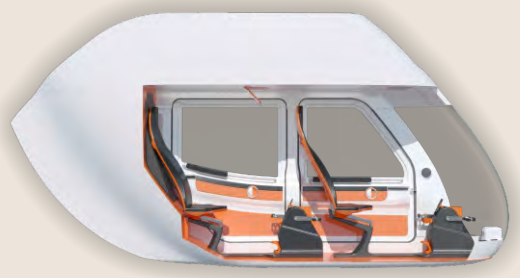


A light and compact vehicle on steel wheels. It combines the features of a high-performance electric vehicle of the transport system and a sports and recreational facility.

In addition to the built-in (and external) power sources, the unibike is equipped with a bicycle generator so that it can be driven by the muscular force of passengers. In the future – an alternative to a car, bicycle and motorcycle.

The model range includes single-, double-, three-, four- and five-seat unibikes.





Maximum speed:
150 km/h.

Performance:
up to 20,000 passengers/hour and more.

Maximum longitudinal slope of the track:
30 %.

HIGH-SPEED TRANSPORT

A mounted vehicle on steel wheels, designed for intercity passenger and cargo transportation for distances up to 10,000 km.

HIGH-SPEED UNIBUS

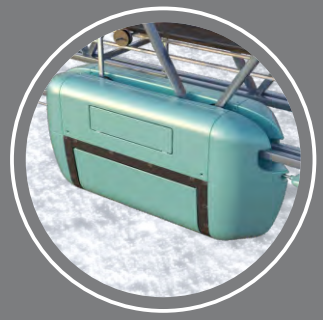
High speed is provided by the specially designed string-rail overpass and high aerodynamic efficiency of the vehicle.

Maximum speed: up to 500 km/h.
Passenger capacity: 4–24 people.
Performance: up to 500,000 passengers/day and more.
Maximum longitudinal slope of the track: up to 20 %.

CARGO
TRANSPORT

Transport system designed for cargo transportation over distances of up to 500 km and more.

UNITRUCK



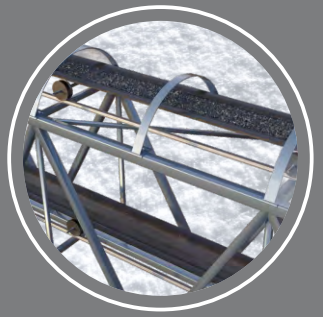
The cargo rolling stock is based on suspended urban passenger unibuses.

A special range of containers was developed to allow docking with maritime, railway and automobile containers for liquid, bulk, break-bulk and special cargo.

Containers for perishable goods are equipped with a thermal control system (in winter) and air conditioning (in summer); containers for environmentally hazardous goods have a multi-layer high-strength body, etc.

Speed of cargo transportation: up to 150 km/h.
Performance: up to 200 mln tonnes/year and more.
Maximum longitudinal slope of the track: up to 30 %.

UNITRANS



The efficiency of the product pipeline is provided by 24/7 year-round continuous operation, which allows to transport large volumes of cargo.

The product pipeline includes a loading and an unloading terminal of special design – with continuous loading and unloading of goods.

It allows fast and cheap transportation of bulk and break-bulk cargo.

The system is indispensable in remote and hard-to-reach places, particularly when developing mineral deposits.

Speed of cargo transportation: up to 36 km/h.
Performance: up to 200 mln tonnes/year and more.
Maximum longitudinal slope of the track: up to 45 %.

Cargo SkyWay area of application:

- transportation of bulk cargo (ore, building materials, coal, etc.);
- transportation of liquid cargo (oil and oil products, natural drinking water, etc.);
- transportation of break-bulk cargo (rolled steel, wood, timber, etc.);
- transportation of containers and Europallets;
- transportation of special cargo (liquefied gases and cryogenic liquids, radioactive and explosive substances, weapons, etc.).

SKYWAY SYSTEM
SEA PORT

The advantages of using the SkyWay cargo transport system in a sea port:

- delivery of goods for the distance of 15–20 km and more from the shore without a significant cost increase;
- mooring of large vessels does not require the creation of quay walls, dredging or shore reinforcement;
- it is possible to deliver goods to a sea port located in the natural depths (up to 50 m);
- a port and the SkyWay transport system form a single logistics complex for the delivery of raw materials, operating in automatic mode;
- the transportation volume of bulk cargo – up to 200 mln tonnes/year and more;
- the type of transportation – from a mining enterprise to a bulk carrier's hold without intermediate stocking.

ECOHOUSE HOUSE OF THE FUTURE TODAY

The time of faceless identical buildings has passed. A man needs eco-friendly architecture being a source of daily spiritual joy. The society has come to the conclusion that people should not conquer the nature, but live with it in full harmony and mutual understanding.

ECO-FRIENDLY

An Ecohouse is built using "green" technologies, as well as environmentally friendly materials that do not harm the nature.
A project considers cardinal points, a wind rose, landscape, human-friendly zoning of internal premises and overall geometry of building construction.

COST-EFFECTIVE

An Ecohouse is provided with heat, electricity and hot water using renewable energy sources – sun, ground, wind.
An integrated approach when designing a building naturally uses renewable energy systems as constructive design elements.

AESTHETIC

An original step towards the reproduction of natural balance – roof gardening – is not only a good view of the roof, but also a sky-high part of the terrestrial ecosystem.
The development of "green" technologies gives the opportunity to create beautiful, multifunctional, environmentally friendly and admirable ecohouses.

LINEAR CITY IN UNITY WITH NATURE

SkyWay tracks contribute to the development of linear cities – cluster-type urban settlements harmoniously integrated into the environment.

The ground surface is intended for pedestrians to walk and plants to grow, whereas transport, power and information communication lines are located above the ground at the "second level". The construction of linear cities will not require cutting down forests, building motor roads and railways, or disturbing biogeocenosis in the construction zone in any similar way.

The SkyWay horizontal lifts will connect neighbouring high-rise buildings, settlements, as well as residential, commercial, entertainment, production and multifunctional clusters. The SkyWay high-speed transport arteries will take you to any point of the Earth.

SkyWay linear cities can be built in the mountains, on desert and flooded territories, including in areas with challenging terrain and on the sea shelf.

BASIC ENGINEERING ELEMENTS

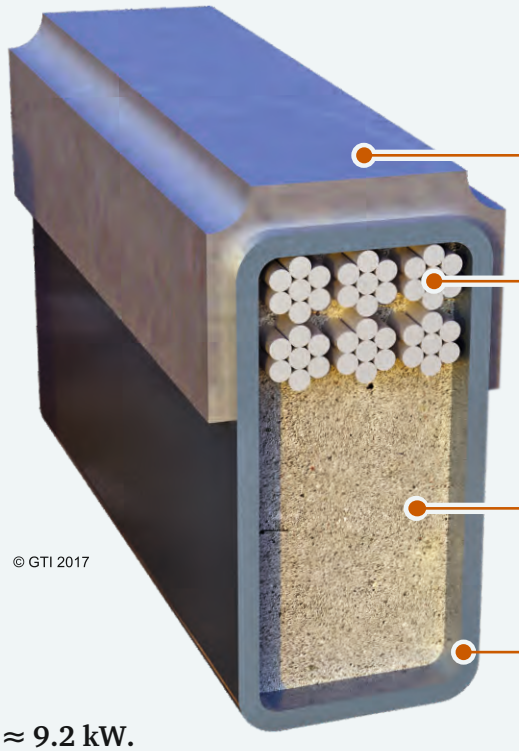
THE BASIS OF SKYWAY TECHNOLOGY – AN INNOVATIVE STRING RAIL

A string rail is an ordinary uncut (along its length) steel, reinforced concrete or steel-reinforced concrete beam or truss equipped with a rail head and additionally reinforced with pre-stressed (stretched) strings.

A string rail combines the features of a flexible thread (at a large span between supports) and a rigid beam (at a small span – under a rail automobile wheel and above the support).

A flat rail head and a cylindrical steel wheel provide minimal energy consumption for movement.

Design variant of a semi-rigid string rail



The power of wheel rolling resistance for a unibus of 5,000 kg at the speed of 450 km/h:

$$W_{w.r.} = M \cdot g \cdot k_{w.r.} \cdot V = 5{,}000\ \text{kg} \cdot 9.81\ \text{m/s}^2 \cdot 0.0015 \cdot 125\ \text{m/s} \approx 9.2\ \text{kW}.$$

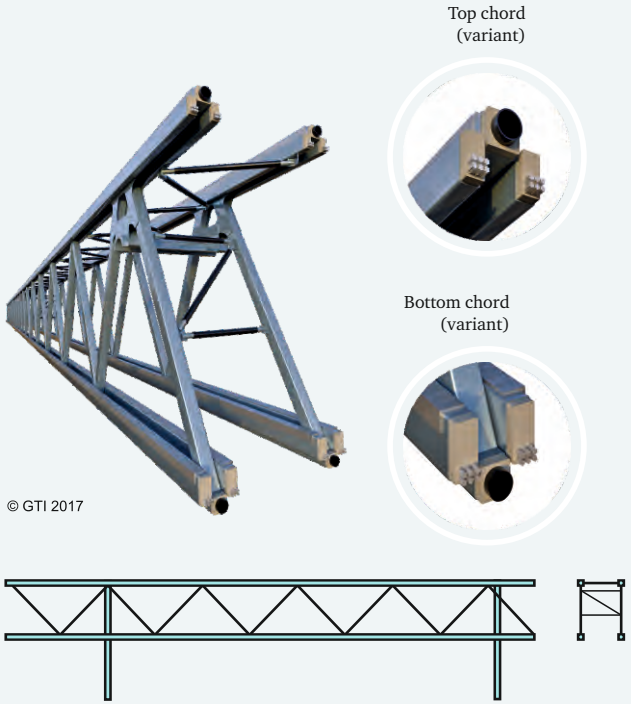
Compare:
when using pneumatic tires with $k_{w.r.} = 0.18$ (for $V = 450$ km/h)

$$W_{w.r.} \approx 1{,}100\ \text{kW}.$$

TYPES OF STRING RAILS AND THE CORRESPONDING DESIGNS OF TRACK STRUCTURE

RIGID RAIL (TRUSS)

Rigid uncut track structure



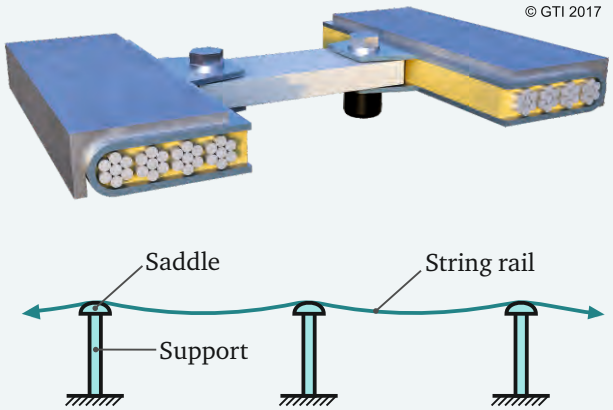
Motion speed:
from 100 to 500 km/h.

Relative structural rigidity:
1/1,000–1/10,000.

Track structure curve radius:
R = 5,000... 50,000 m.

FLEXIBLE RAIL

Flexible uncut track structure



It is not an analogue to cableway:

- use of rail
  (lower wheel rolling resistance);
- lower energy consumption for movement
  (by 3–5 times less);
- possibility of using a gravity engine and gravity brake
  (reduced energy consumption by another 3–5 times);
- high durability (by 5–7 times higher).

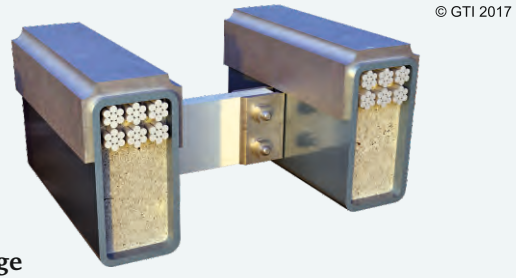
Motion speed:
from 30 (on support) up to 150 km/h.

Relative structural rigidity:
1/100–1/500.

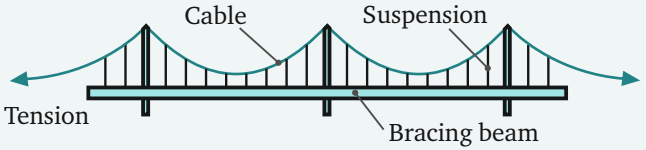
Track structure curve radius:
R = 100 (on support)... 2,000 m.

SEMI-RIGID RAIL

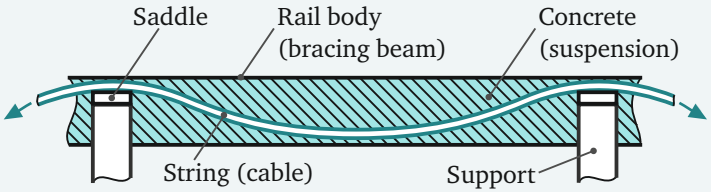
Semi-rigid uncut track structure



Hanging bridge



The SkyWay track structure design follows the design of a hanging bridge combining all its main elements



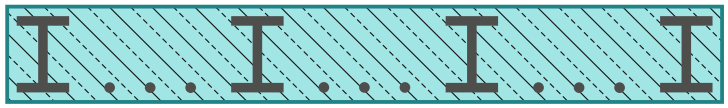
Motion speed:
from 50 up to 250 km/h.

Relative structural rigidity:
1/500–1/2,000.

Track structure curve radius:
R = 500... 5,000 m.

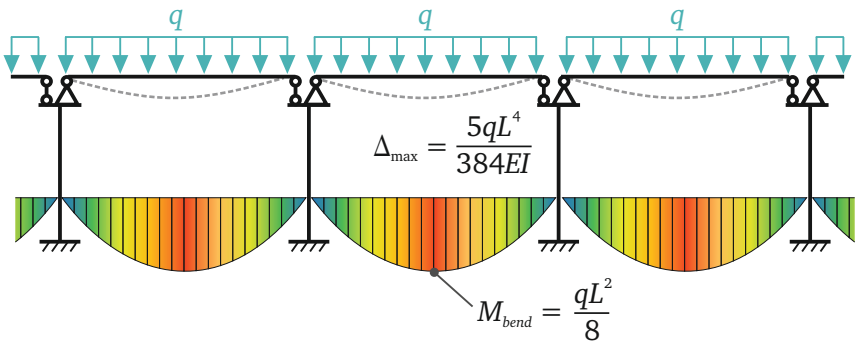
SKYWAY TECHNOLOGY
VS CONVENTIONAL BEAM OVERPASS

Split overpass (conventional bridge)

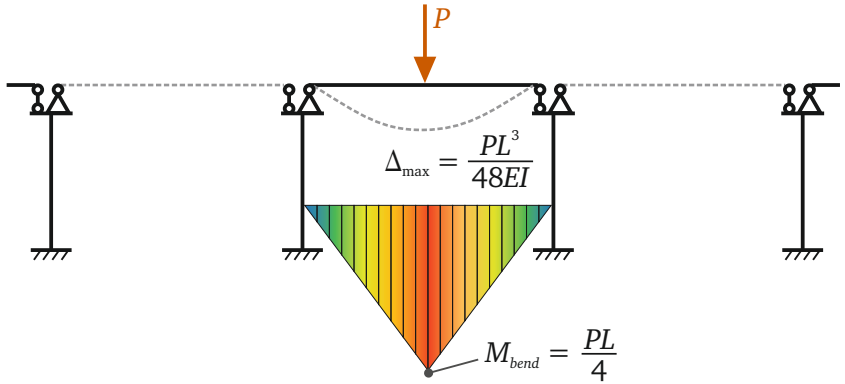


A solid roadbed gives additional load on supports and has a high cost.

Bending moment diagram with distributed load



Bending moment diagram with concentrated force

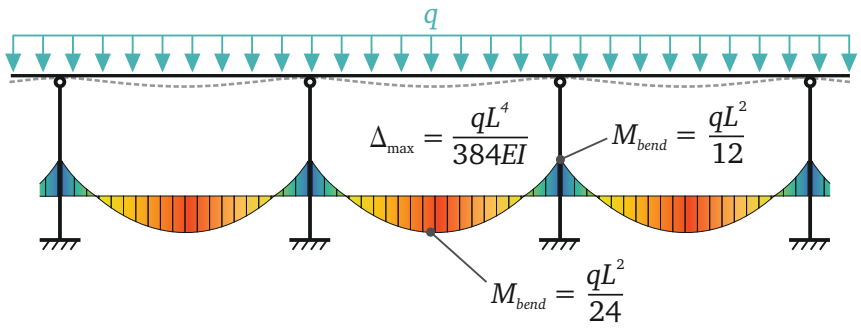


90 %

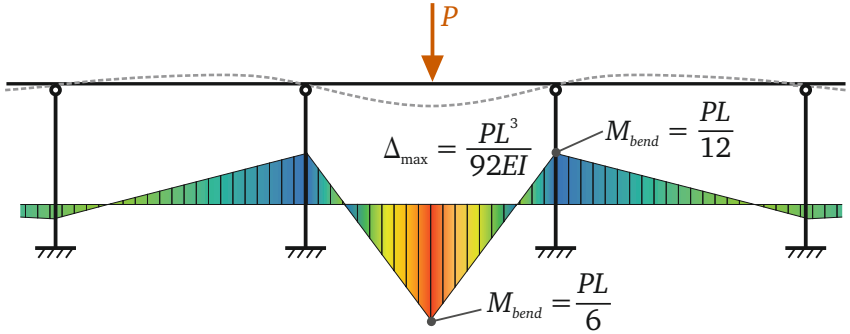
of load in a conventional overpass – its own weight. The overpass carries itself, not the useful load.

Innovative uncut pre-stressed rail-string overpass (SkyWay technology)

Bending moment diagram with distributed load



Bending moment diagram with concentrated force



With equally distributed load, the SkyWay overpass is 5 times more rigid (smoother) and 3 times stronger than a conventional bridge.

With equally concentrated force, the SkyWay overpass is 1.9 times more rigid (smoother) and 1.5 times stronger than a conventional bridge.

The SkyWay overpass decreases the amount of building materials required for its construction compared to a conventional overpass.
As a result, the construction cost is significantly reduced.

10 %

of load in a SkyWay overpass – its own weight.
The overpass carries the useful load, not itself in contrast to conventional bridges.

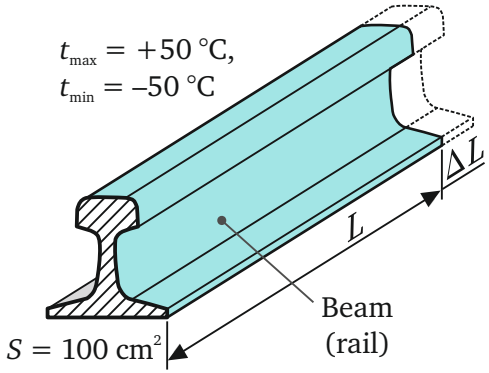
PRE-STRESSED

AN OPTIMAL SOLUTION TO COMPENSATE THERMAL DISTORTION

Under thermal effects:

– absolute deformation
$\Delta L = a \cdot L \cdot \Delta t$;

– relative deformation
$\varepsilon = \frac{\Delta L}{L} = a \cdot \Delta t$.



For steel,
the thermal coefficient of linear expansion (per 1 °C)

$a = 0.000012$

with $\Delta t = 100$ °C, $\varepsilon = 0.0012 = 1/833$
(the extension will be 1.2 m per 1 km).

Test of a rigidly restrained beam for strength and stability under thermal effect ($\Delta t = 100$ °C)

Without tension

Compressive buckling.

With tension

The beam is not subject to compressive buckling.

Test of a rigidly restrained beam for strength and stability under thermal effect ($\Delta t = 100$ °C)

Test for strength:

– compression strain of longitudinal fibres:
$\Delta\sigma = E \cdot \varepsilon = E \cdot a \cdot \Delta t \leq \sigma_{02}$.

For steel,

with $E = 2 \cdot 10^6$ kgf/cm^2 and $\Delta t = 100$ °C:
$\Delta\sigma = 2 \cdot 10^6 \cdot 0.0012 = 2{,}400$ kgf/cm^2.

Test for stability:

– longitudinal compression force arising in a restrained beam at temperature differences:

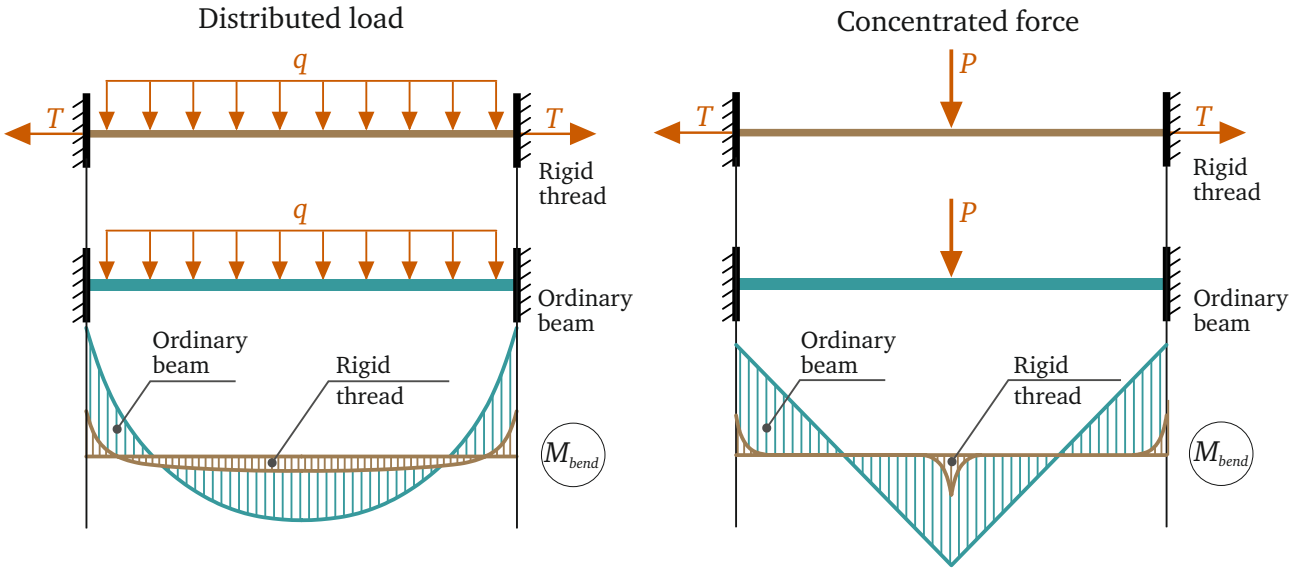
$$N_{comp} = \sigma \cdot S = E \cdot a \cdot \Delta t \cdot S \leq N_{cr.f} = \frac{4\pi^2 EI}{L^2}.$$

For steel,

with $S = 100$ cm^2 and $\Delta t = 100$ °C,
$\Delta N = 2{,}400 \cdot 100 = 240$ tf.

With the pre-stressing force more than 240 tf, there will be no compression forces in the structure and it will not lose its stability.

Bending moment diagrams in a restrained beam (conventional design) and in a pre-stressed rigid thread (SkyWay design)



Bending moments in a rigid thread are by 10 times lower than in a conventional beam.

Conclusion

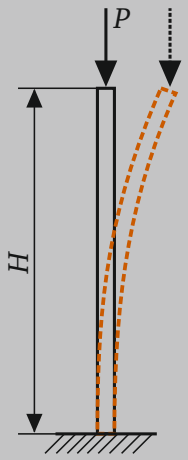
The most dangerous phenomenon when heating a rigidly restrained beam is the loss of its stability.

Solution

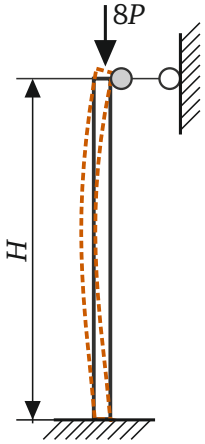
A pre-stressed beam with the rated force of $T \geq N_{\Delta t}$ ensures that even temperature difference of $\Delta t = 100$ °C will not cause compression forces in longitudinal fibers of the beam.

HIGH EVENNESS OF THE TRACK

IS ACHIEVED DUE TO USING AN UNCUT STRING RAIL BETWEEN ANCHOR SUPPORTS

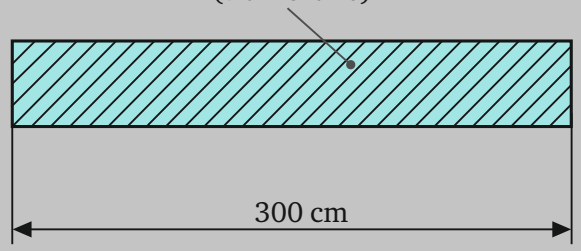


Loss of stability
in an ordinary support



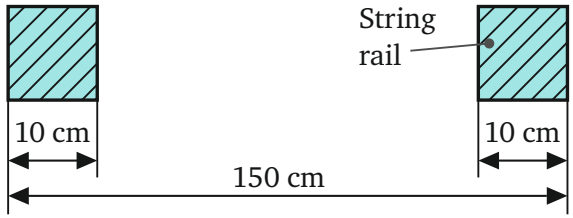
Loss of stability
in a SkyWay support

Conventional overpass bed
(traffic lane)



Construction cost of a conventional overpass with ordinary supports – from 100 mln USD/km.

SkyWay
track structure

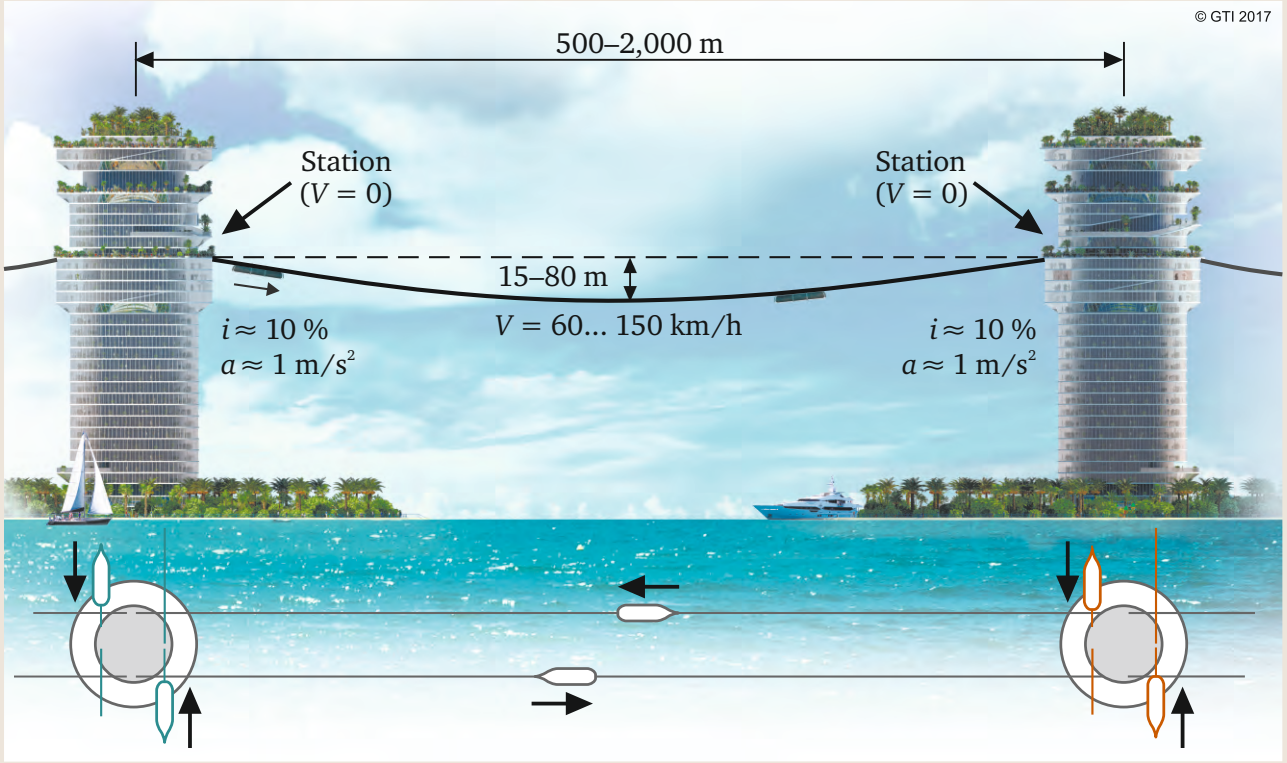


Construction cost
of a SkyWay overpass –
from 2 mln USD/km.

- Intermediate supports installed at a span from 25 up to 100 metres (to ensure rigidity of the uncut track structure) allow to use light structures.
- Fixing of the support top to the track structure additionally increases its load-bearing capacity by 8 times.
- The amount of materials required for installation of supports can be reduced by 8 times, resulting in cost reduction by the same figure.

An uncut structure of the string rail in its overpass design reduces the amount of building materials and their cost by 15 times and more compared to a conventional beam overpass.

APPLICATION OF ENERGY CONSERVATION LAW IN INNOVATIVE SKYWAY TRANSPORT



In terms of energy consumption, an overpass with a sagging track structure is by times more efficient than a road with a straight track structure.

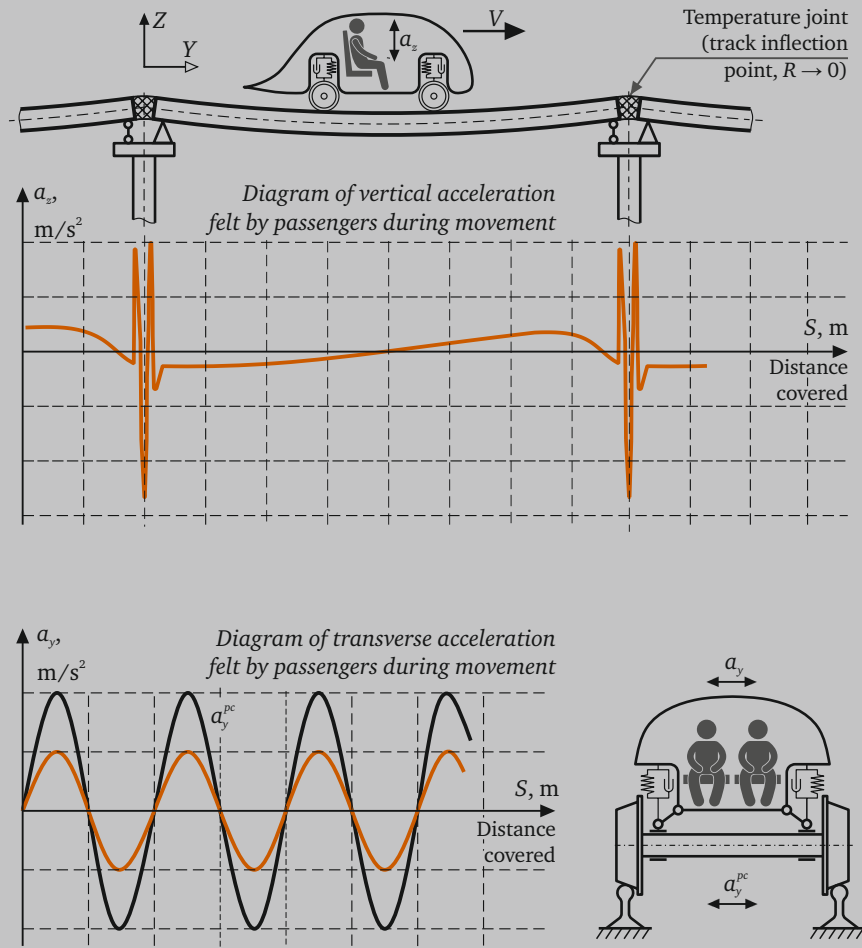
The drive in the SkyWay transport system with a sagging track structure is only required to compensate for aerodynamic losses and to overcome steel wheels rolling resistance on a steel rail (about 10 kW for a 50-seat vehicle). It is explained by the fact that an engine is not used at a downhill section of the track – a vehicle is accelerated by gravity ("gravity" engine).

The unibus does not need brakes at an uphill section – it is slowed down by gravity ("gravity" brakes).

Energy recuperation takes place without using a recuperator, according to the laws of physics. The efficiency factor of this recuperation is 100 %.

SMOOTH MOVEMENT

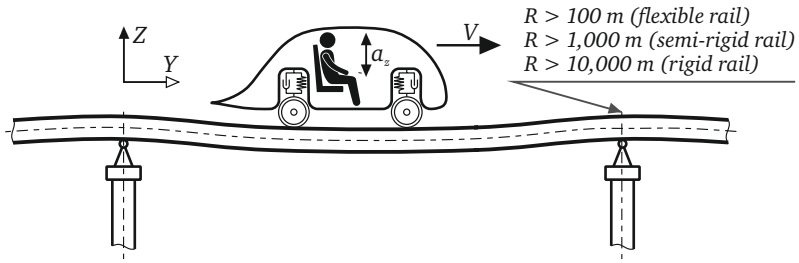
Split overpass (conventional bridge)



Disadvantages:

- peak acceleration values when moving through supports;
- more complicated design of the supporting node with a temperature joint.

Uncut pre-stressed overpass (SkyWay technology)



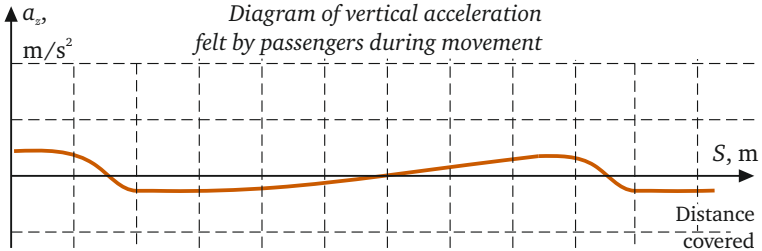


Diagram of vertical acceleration felt by passengers during movement

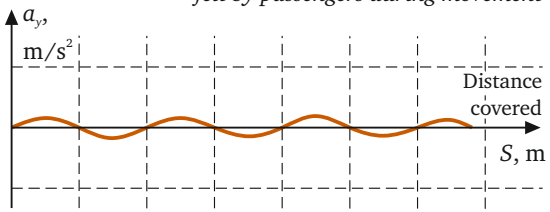
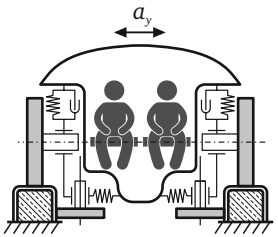


Diagram of transverse acceleration felt by passengers during movement



Advantages:

- smooth change of acceleration when moving through supports;
- more simple design of the supporting node.

Passenger comfort is estimated by smooth movement *W*:

$$W = 2.7k\sqrt[10]{A^3 \cdot f^5},$$

where k – coefficient, which depends on direction and vibration frequency;
A – vibration amplitude, cm;
f – vibration frequency, Hz.

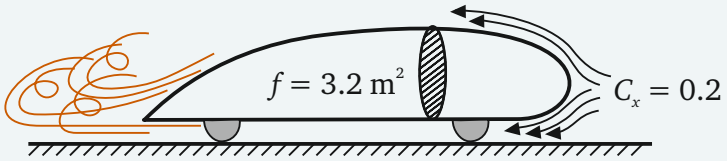
Evaluation	Index of smooth movement, *W*
Very good	Less than 2
Good	2–2.5
Satisfactory for passengers	2.5–3
Impermissible for passengers	3–3.25
Permissible for cargo	3.6–4.25
Unsafe for passengers from the physiological perspective	4.5

SkyWay Highway and railway

AERODYNAMICS OF A WHEELED VEHICLE

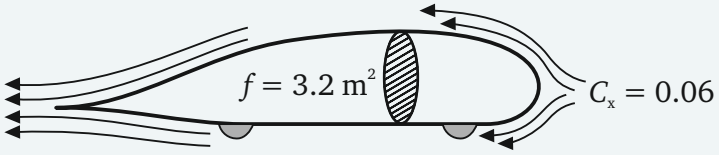
Wind tunnel tests of the innovative SkyWay rolling stock (unibus) in 1994–2009 gave the result $C_x = 0.075$.

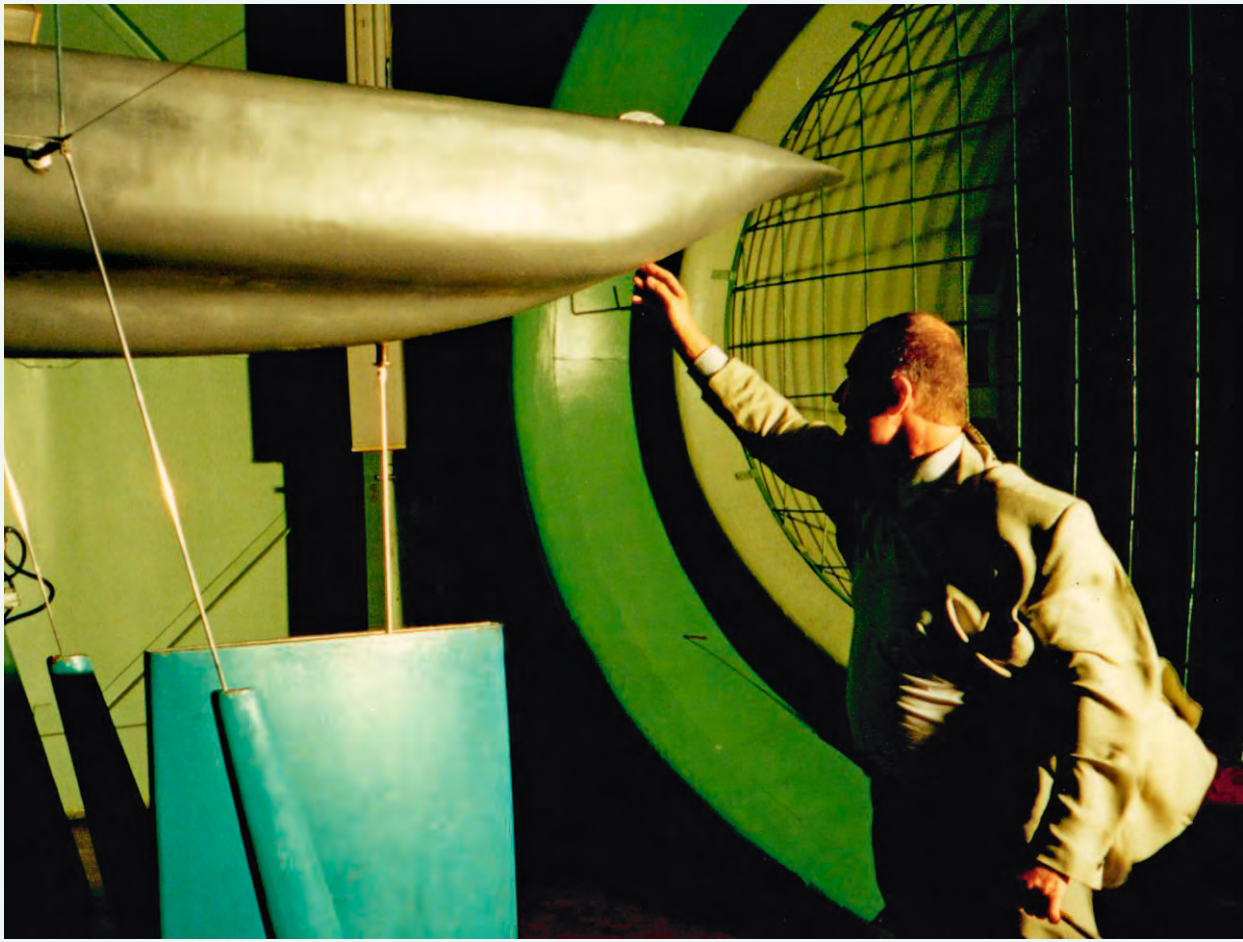
This provides saving of drive power in one SkyWay vehicle of about 600 kW compared to the most advanced of alternative ground vehicles ($C_x = 0.2$).



Aerofoil effect causes turbulence.

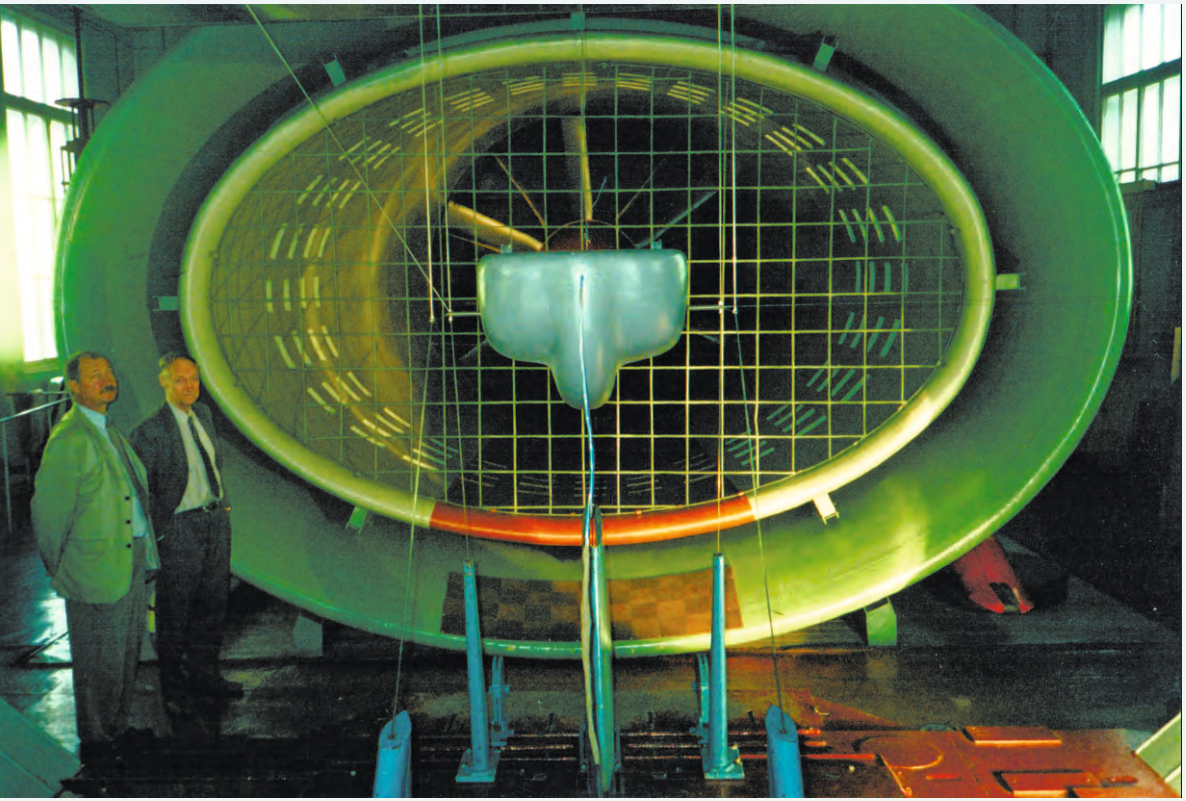
As a result of wind tunnel tests carried out in 2017, C_x of the SkyWay rolling stock was improved to 0.06: $\Delta C_x = 0.2 - 0.06 = 0.14$.





Power saving of aerodynamic resistance (at a speed of 450 km/h):

$$\Delta W_{a.r.} = \frac{1}{2}\rho \cdot V^3 \cdot \Delta C_x \cdot f \cdot k = \frac{1}{2} \cdot 1.25\ \text{kg/m}^3 \cdot (125\ \text{m/s})^3 \cdot 0.14 \cdot 3.2\ \text{m}^2 \cdot 1.1 \approx 600\ \text{kW}.$$



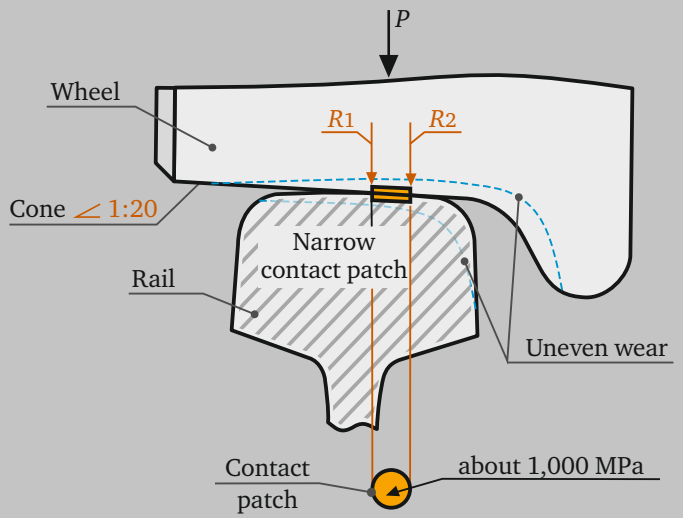
Energy (fuel) saving by one high-speed unibus for 25 years of operation will be about 22,000 tonnes, at the cost of about 20 mln USD.

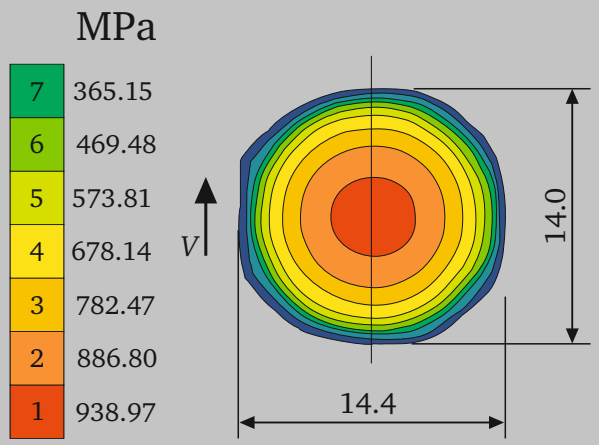
Thus, a thousand unibuses with unique aerodynamic properties can save over 20 mln tonnes of fuel, at the cost of more than 20 bln USD. Along with this, 80 bln tonnes of atmospheric oxygen will be saved from burning out and more than 20 bln tonnes of polluting substances will not be generated.

The location of the track structure above the ground and the absence of a solid roadbed eliminates the main problem of high-speed transport – aerofoil effect. This alone allows to improve vehicle aerodynamics twofold.

ADVANTAGES OF SKYWAY STEEL WHEELS

Conventional railway wheel

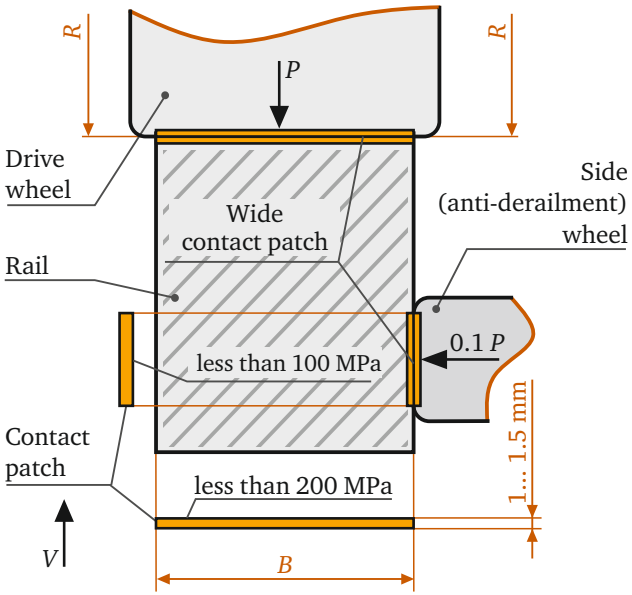




Increased wheel wear and noise due to:

- big contact stresses (1,000 MPa and more) caused by a small size of the contact patch;
- slipping in the contact patch caused by a difference of seating diameters in the conical wheel surface;
- operation of brake mechanisms (brake shoes cause additional wheel thread wear);
- big static and dynamic wheel loads combined with inevitable track irregularities;
- a rigid wheel pair prone to self oscillations, which increase wear and noise;
- asymmetrical load application onto the rail head.

Innovative unibus wheel



Calculation of contact stress for a high-speed unibus with gross weight of 5 tonnes:

$$\sigma_c = 0.418 \cdot \sqrt{\frac{P \cdot E}{B \cdot q \cdot R}} = 0.418 \cdot \sqrt{\frac{1{,}250\ \text{kgf} \cdot 2.1 \cdot 10^6\ \text{kgf/cm}^2}{8\ \text{cm} \cdot 0.8 \cdot 26\ \text{cm}}} = 1{,}660\ \text{kgf/cm}^2 = 163\ \text{MPa},$$

where P – wheel load;

E – effective elastic modulus;

B – width of wheel supporting part;

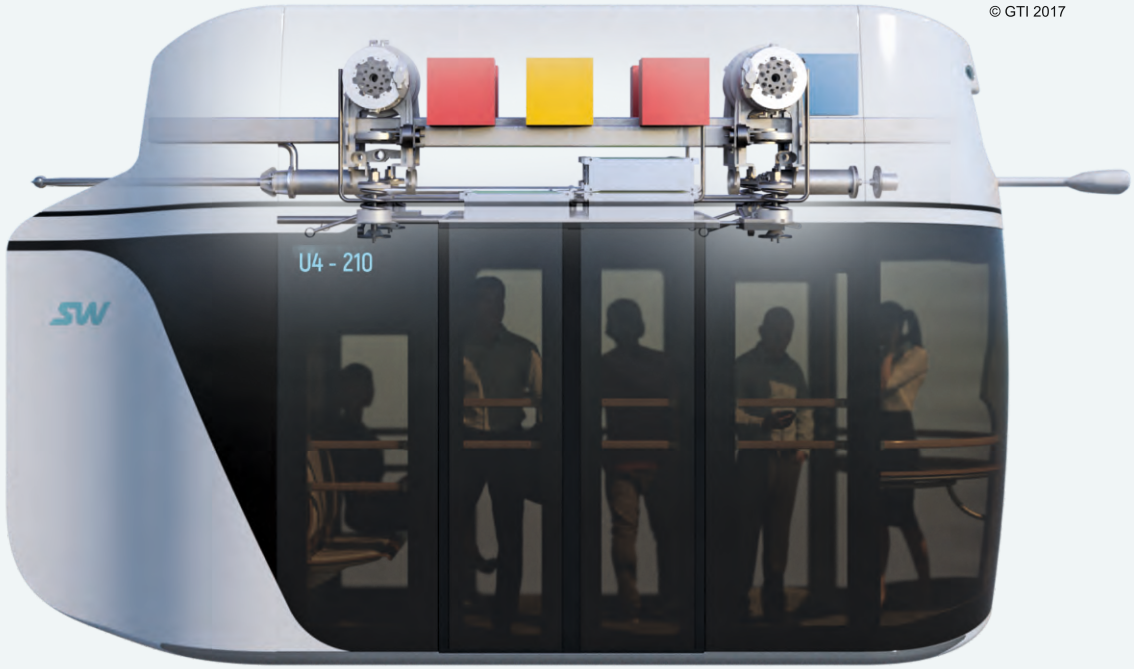
R – wheel radius;

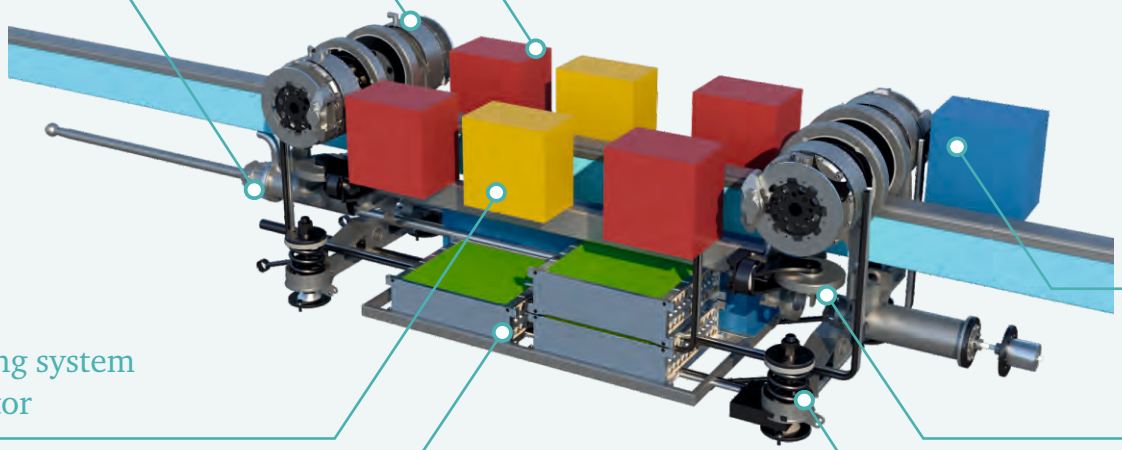
q – coefficient of contact irregularity by length.

Advantages of SkyWay transport wheels:

- insignificant contact stress (less than 200 MPa) due to a wide contact patch (by rail head width);
- no slipping in the contact patch (cylinder rolling along the plane);
- disk brake mechanisms and ABS preventing wheels locking;
- small wheel load and absence of joints on the track;
- symmetrical rail head wear (vertically and horizontally);
- minor wheel rolling resistance due to a narrow contact patch (in the direction of wheel rolling).

CHASSIS
LAYOUT





Motor invertor

In-wheel motor

Emergency drawbar

Cooling system radiator

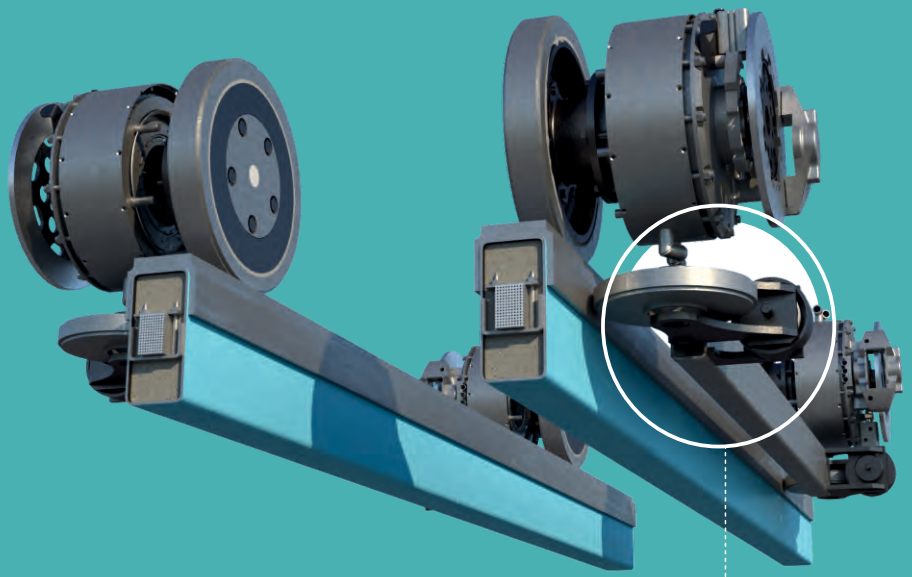
Accumulator battery

Voltage converter

Anti-derailment system

Suspension springs

SAFETY
OF TRANSPORT SYSTEMS



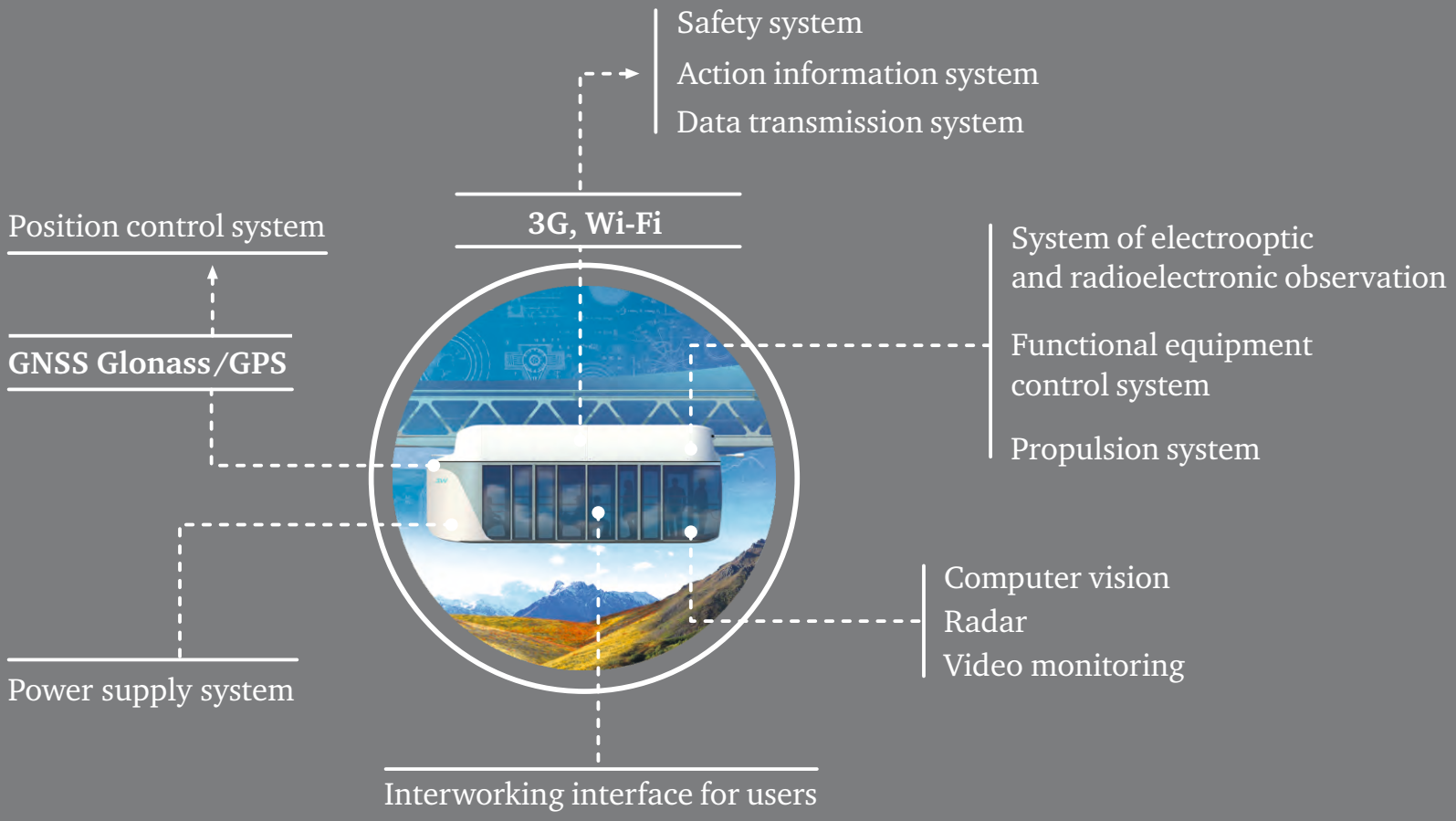
High resistance to vandalism and acts of terrorism

Location of the track structure above the ground enhances traffic safety by appr. 100 times

Anti-derailment system increases traffic safety by another 10 times

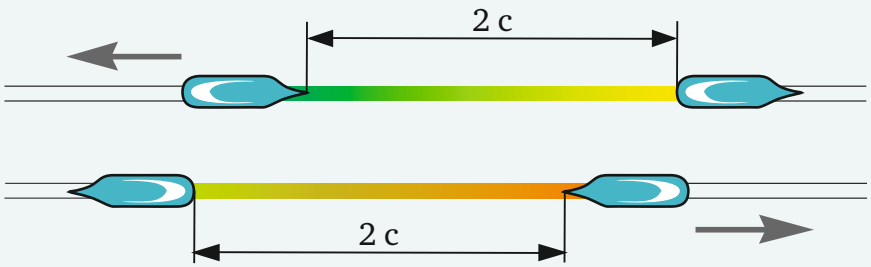
AUTOMATED CONTROL SYSTEMS
OF SKYWAY TRANSPORT COMPLEX

The control system of SkyWay transport complex comprises a wide range of wireless and wired communications based on conventional information and electronic technologies.



The implementation of SkyWay complexes will increase the efficiency of transportation management, reduce overhead costs for passenger and cargo transportation and boost the development of the informational space on a global scale.

TRANSPORTATION CAPACITY
OF INNOVATIVE SKYWAY TRANSPORT SYSTEM



A safe time interval between unibuses for real-time control systems is 2 seconds.

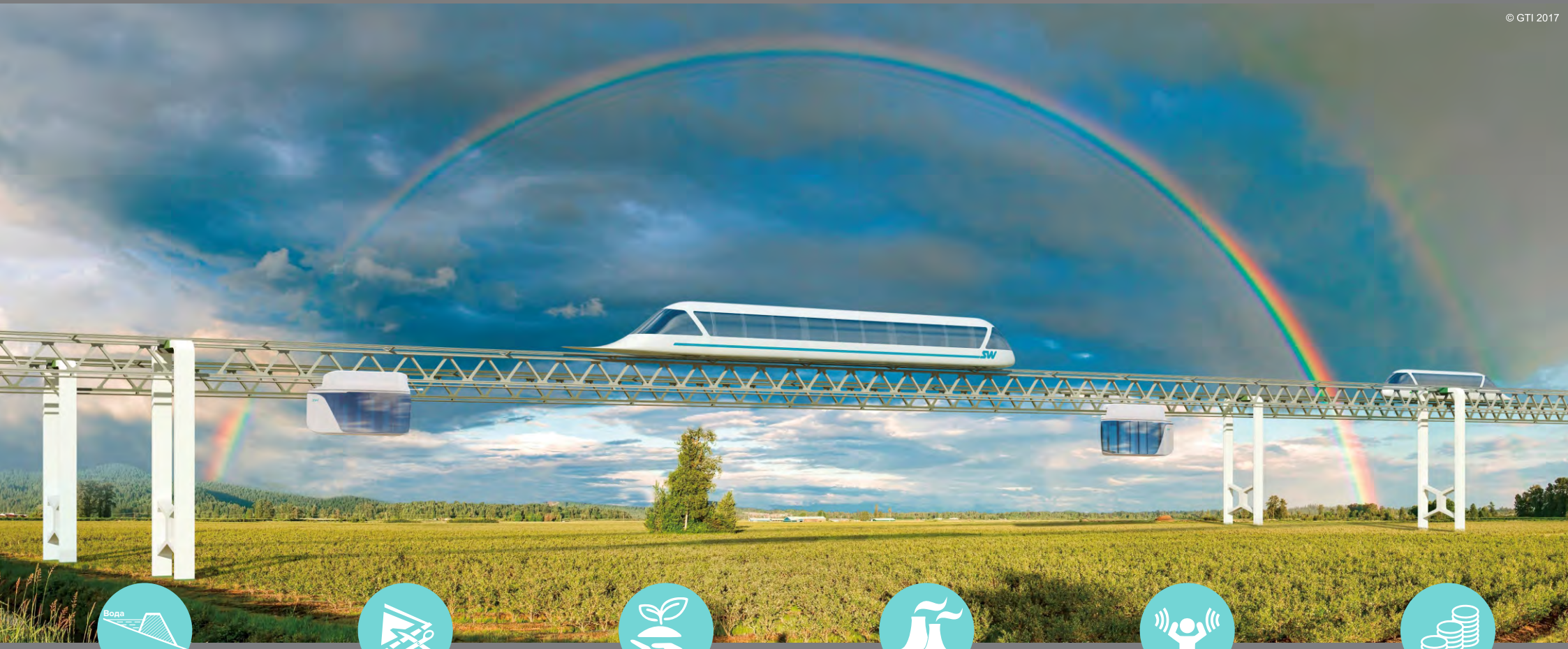
The indicated requirements are recommended by the Automated People Mover (APM) Standards Committee.

The peak traffic capacity of the SkyWay transport system at 20-hour operation – 360,000 passengers per day in one direction (considering the permitted interval of 2 seconds and the basic capacity for a single unibus of 10 seats).

The peak traffic capacity for a bidirectional system – 720,000 passengers per day.

SkyWay performance can be additionally increased by raising modules capacity and uniting them in trains.

SKYWAY AND ECOLOGY



No earth embankment (low-pressure dam)

Minimal local land acquisition (reduced by 20 times)

Preservation of natural ecosystems and geobiocenosis

Reduced amount of hazardous emissions into the atmosphere (by times) due to less power consumption

Increased electrical, vibro- and noise safety (by 10 times)

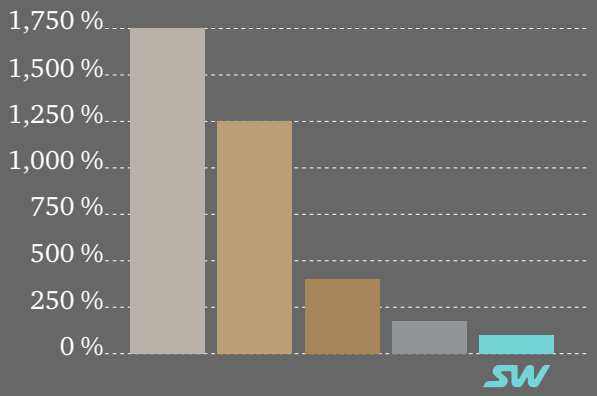
Reduced resource consumption – saving of raw materials, land, power, labour and finances

SKYWAY COMPARED

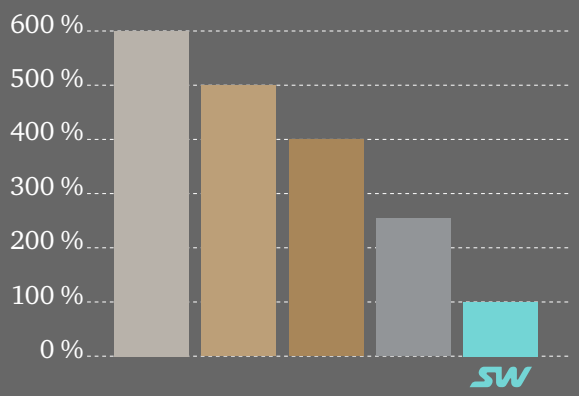
TO THE EXISTING AND ADVANCED ANALOGUES

As estimated by the Russian Academy of Sciences, the innovative SkyWay transport technology is the most cost-efficient, sustainable and safe of all existing and advanced transport systems.

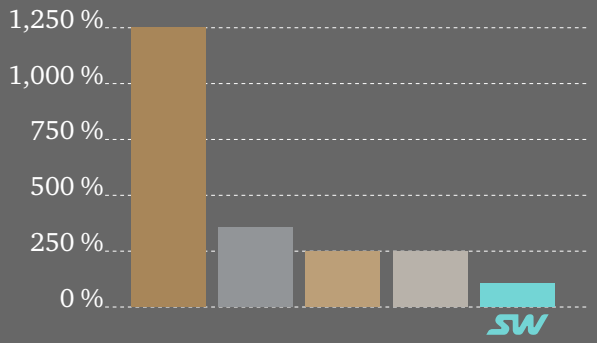
CAPEX



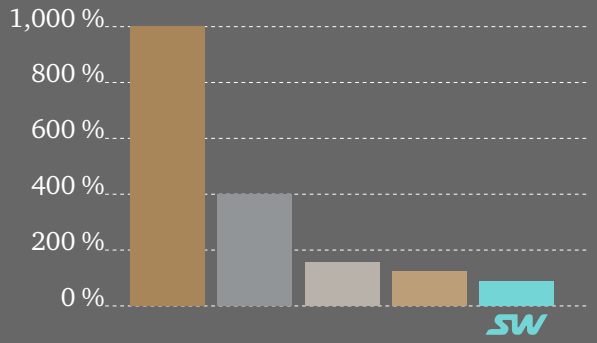
OPEX



Environmental pollution



Traffic accident rate



Maglev

Monorail

Motor transport

Railway

SkyWay string transport

ADVANTAGES OF HIGH-SPEED SKYWAY

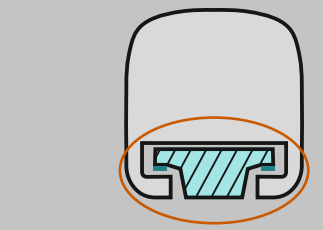
Maglev

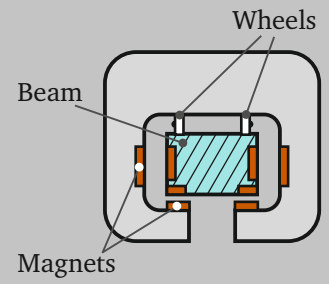
The track structure operation is more labour intensive due to its complicated configuration and technical components (electric coils, switching devices, etc.), which require constant maintenance and machinery for cleaning the track from snow and icing.

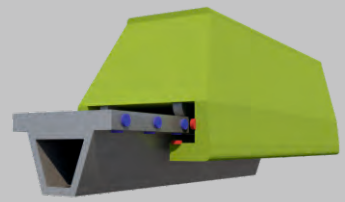
The track structure is expensive as it has a massive roadbed. The installation of electric coils and a complicated anti-derailment system is required.

Overpass cost – from 50 mln USD/km.

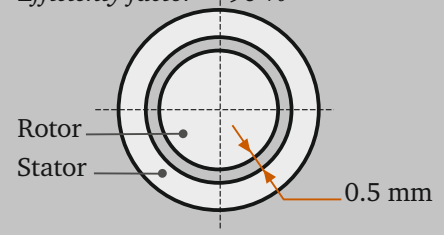
The use of a linear electric motor gives the efficiency factor not more than 50 % as the clearance between a rotor and a stator (e.g. in Transrapid) cannot be less than 10 mm. However, the clearance should not exceed 0.5 mm for the effective electric motor operation.



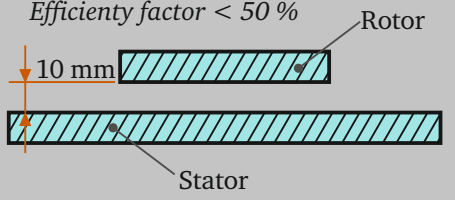


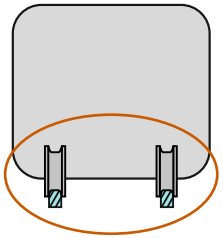


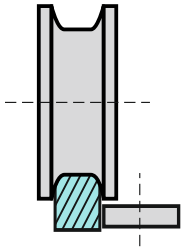
Electric motor
Efficienty factor > 90 %

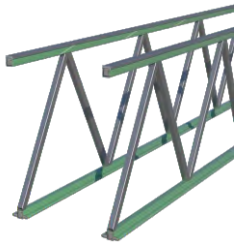


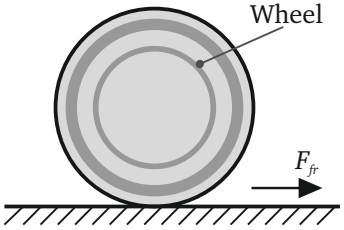
Linear electric motor
Efficienty factor < 50 %











High-speed SkyWay

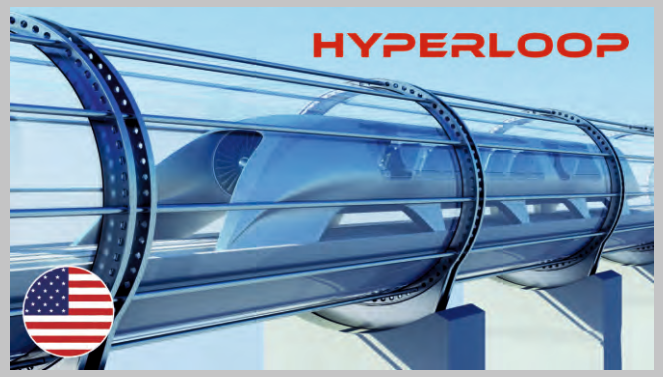
The track structure operation does not require any additional machinery as it is capable of self-cleaning (e.g. from snow and icing) and has no complicated technical elements (electric coils, etc.).

The SkyWay track structure is lighter and cheaper due to its elegant design. It does not require the installation of electric coils and provides a simple anti-derailment system.

Overpass cost – from 2 mln USD/km.

The use of a steel wheel gives the efficiency factor over 99.8 %.

OUR COMPETITORS



The technology of high-speed transport system developed by American billionaire Elon Musk, the founder of SpaceX and Tesla Motors, proposes the movement on an air or magnetic cushion in a vacuum tube.

SkyWay is cheaper and more effective by 10–15 times.

The technology of passenger transportation using personal vehicles operating on a magnetic cushion is developed by an Israeli company SkyTran with the support of NASA (USA).

SkyWay is cheaper and more effective by 3–5 times.

PRACTICAL IMPLEMENTATION

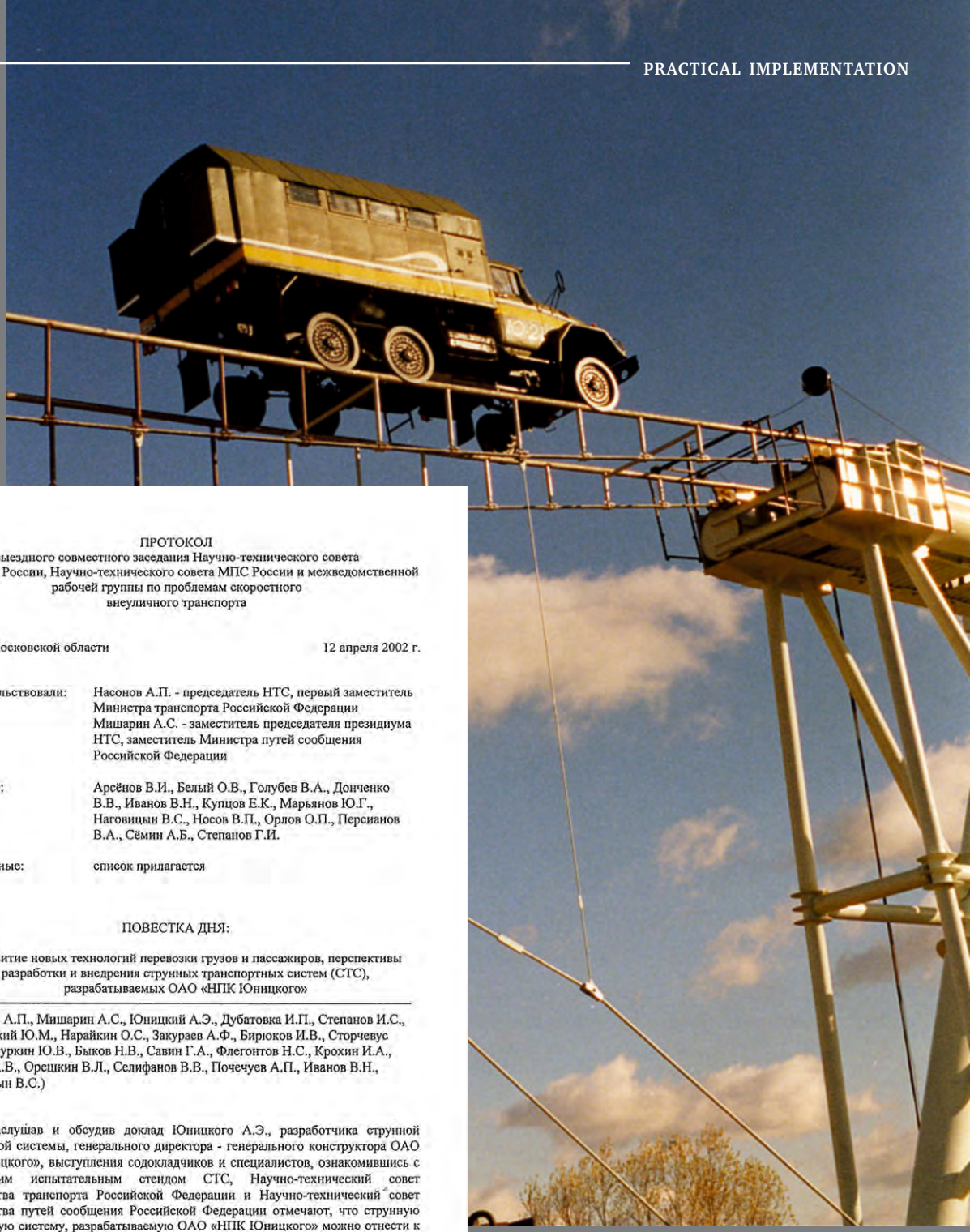
BENCH TESTS OF SKYWAY TRACK STRUCTURE

The Minutes of the visiting joint session of the Scientific and Technical Council for the Ministry of Transport of Russia, the Scientific and Technical Council for the Ministry of Communications of the Russian Federation and the interagency working group on problems of rapid off-street transport (Ozyory, Moscow region, April 12, 2002):

"...The string transport system can be considered as one of the new advanced non-conventional types of elevated transport, which previously proved its feasibility..."

"It is recommended to work out the question on the development of a test base."

"It is recommended to address the issue of project support and financing."



ПРОТОКОЛ
выездного совместного заседания Научно-технического совета Минтранса России, Научно-технического совета МПС России и межведомственной рабочей группы по проблемам скоростного внеуличного транспорта

г. Озёры, Московской области — 12 апреля 2002 г.

Председательствовали: Насонов А.П. - председатель НТС, первый заместитель Министра транспорта Российской Федерации
Мишарин А.С. - заместитель председателя президиума НТС, заместитель Министра путей сообщения Российской Федерации

Члены НТС: Арсёнов В.И., Белый О.В., Голубев В.А., Донченко В.В., Иванов В.Н., Купцов Е.К., Марьянов Ю.Г., Наговицын В.С., Носов В.П., Орлов О.П., Персианов В.А., Сёмин А.Б., Степанов Г.И.

Приглашенные: список прилагается

ПОВЕСТКА ДНЯ:

«Развитие новых технологий перевозки грузов и пассажиров, перспективы разработки и внедрения струнных транспортных систем (СТС), разрабатываемых ОАО «НПК Юницкого»

(Насонов А.П., Мишарин А.С., Юницкий А.Э., Дубатовка И.П., Степанов И.С., Ободовский Ю.М., Нарайкин О.С., Закураев А.Ф., Бирюков И.В., Сторчевус В.К., Чепуркин Ю.В., Быков Н.В., Савин Г.А., Флегонтов Н.С., Крохин И.А., Петров А.В., Орешкин В.Л., Селифанов В.В., Почечуев А.П., Иванов В.Н., Наговицын В.С.)

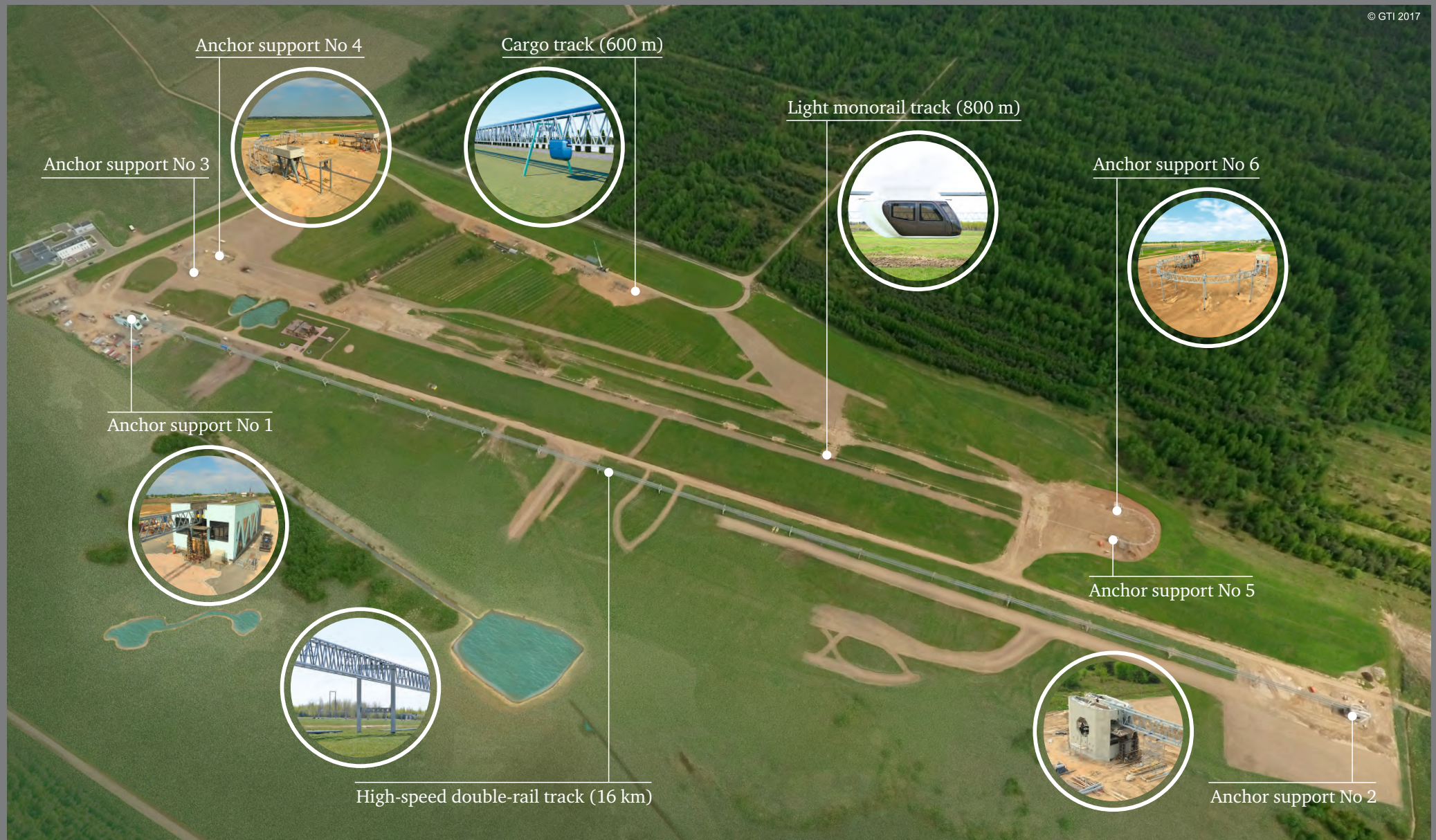
1. Заслушав и обсудив доклад Юницкого А.Э., разработчика струнной транспортной системы, генерального директора - генерального конструктора ОАО «НПК Юницкого», выступления содокладчиков и специалистов, ознакомившись с действующим испытательным стендом СТС, Научно-технический совет Министерства транспорта Российской Федерации и Научно-технический совет Министерства путей сообщения Российской Федерации отмечают, что струнную транспортную систему, разрабатываемую ОАО «НПК Юницкого» можно отнести к одному из новых перспективных нетрадиционных видов надземного транспорта, предварительно показавшего свою жизнеспособность.

SKYWAY TECHNOLOGIES CO. PROJECT –

ECOTECHNOPARK

EcoTechnoPark is a centre for practical implementation of state-of-the-art SkyWay technologies, their international expert evaluation and certification.

The construction of EcoTechnoPark (area – 35.9 ha) is carried out near the town of Maryina Gorka (Republic of Belarus).



EcoTechnoPark aims to:

- demonstrate the working industrial prototypes of SkyWay transport and infrastructure complexes: cargo, urban and intercity high-speed;
- facilitate the certification process for every complex and their components – a transport overpass, rolling stock, infrastructure, etc.;
- contribute to the constant development and improvement of the SkyWay technology;
- demonstrate the ecological potential of the SkyWay technology – minimal footprint for the track, reduced material and power (fuel) consumption in the course of construction and operation, etc.;
- showcase the related communications infrastructure, including ecogenic bio- and agrotechnologies.

SKYWAY

INTERNATIONAL RECOGNITION

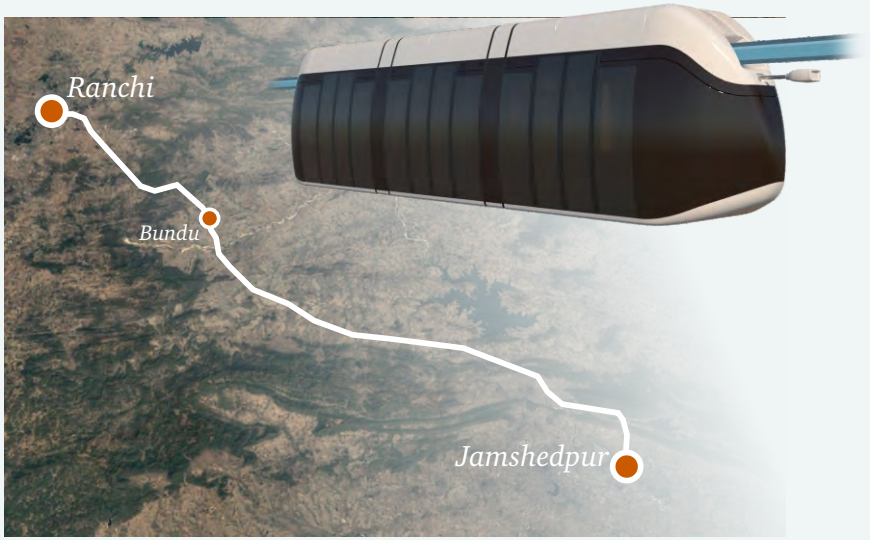
SKYWAY AT INNOTRANS'2016

In September 2016, SkyWay participated in the largest international transport exhibition – InnoTrans'2016. It is one of the most significant events in the world of transport technologies, which determines the main development trends in this field for decades ahead. More than 2,900 exhibitors from 58 countries participated in InnoTrans'2016 with the intention to show their innovations and inventions.

The SkyWay stand included industrial designs of a unibike and a unibus, the operating model of the track structure and the security module of the SkyWay intellectual string fencing. The innovative SkyWay exposition attracted thousands of visitors every day.

FIRST COMMERCIAL PROJECTS

Urban track in Ranchi (India) (Stage 1, over 12 km)



Ranchi – Jamshedpur Intercity Track (India) (129 km)

The comprehensive solution to Jharkhand transport problems is estimated to cost 926 mln USD. It is planned to create about 1,000 jobs.

The potential market for SkyWay transport systems – the whole world. However at the initial stage, the focus is made on the countries and markets:

- demonstrating significant economic growth;
- whose transport infrastructure does not meet the actual needs for growth;
- that do not have their own technological base for a comprehensive solution of transport problems.

UAE

- In Dubai, the population grows by about 6 % per year, while the number of registered cars – by 17 % per year.
- Only 7 % of trips is made by public transport.

INDIA

- Over the past 50 years, the traffic has grown by 150 times, whereas the road network – only by 9 times (since 1951).
- The quality of roads is rather poor, which leads to annual economic losses of 40–70 bln USD.

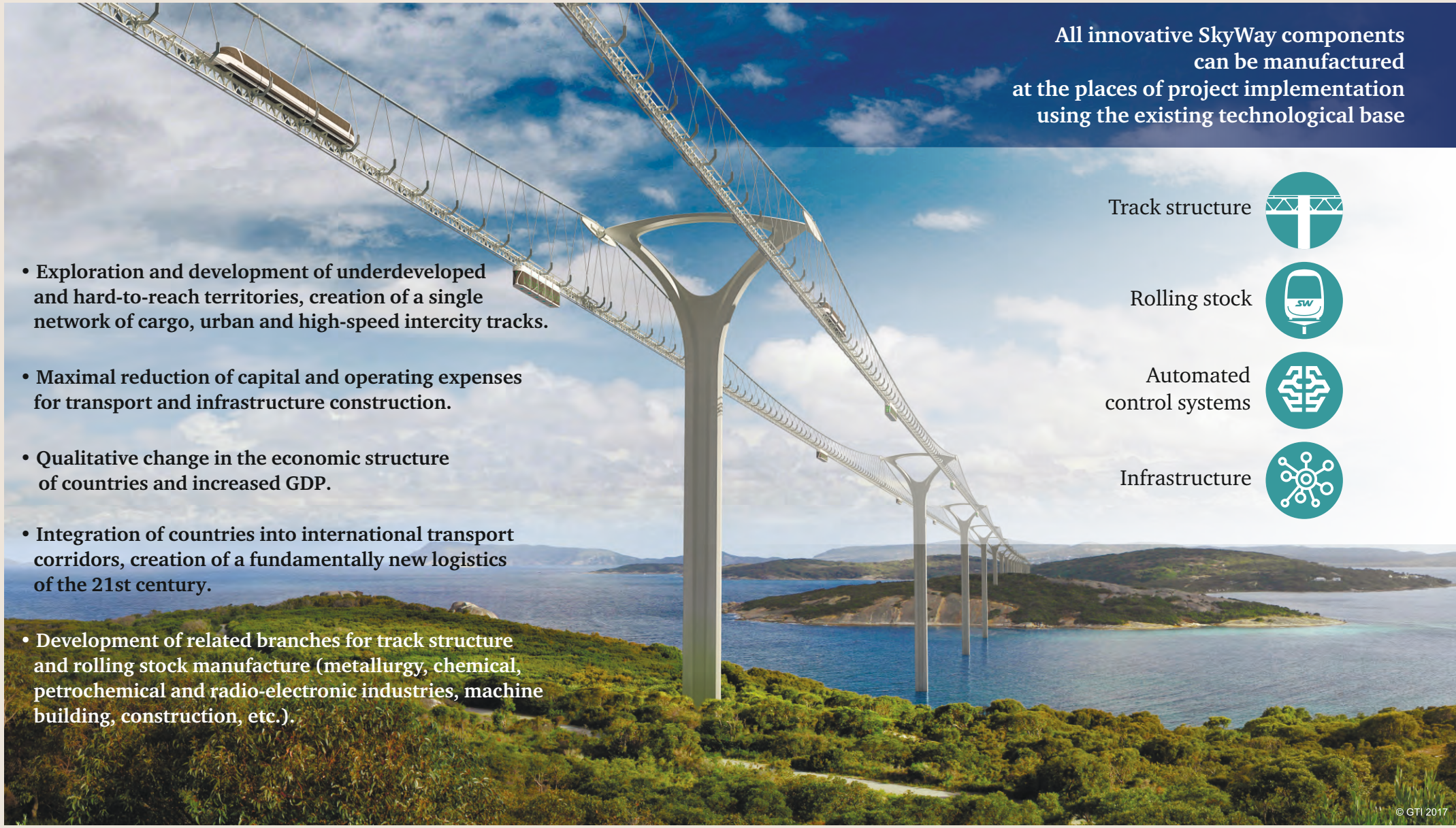
INDONESIA

- In Jakarta, the cost of idling in traffic jams in 2009–2010 increased from 4 bln USD to 5.2 bln USD.
- 70 % of the total road network is poorly maintained, 35 % – heavily damaged.

AUSTRALIA

- 76 % of the population lives on less than 10 % of the territory.
- Without capital investments in additional infrastructure, the cost of urban congestion will increase fourfold in twenty years.

PROSPECTS FOR SKYWAY TECHNOLOGY APPLICATION



All innovative SkyWay components can be manufactured at the places of project implementation using the existing technological base

- Track structure
- Rolling stock
- Automated control systems
- Infrastructure

- **Exploration and development of underdeveloped and hard-to-reach territories, creation of a single network of cargo, urban and high-speed intercity tracks.**
- **Maximal reduction of capital and operating expenses for transport and infrastructure construction.**
- **Qualitative change in the economic structure of countries and increased GDP.**
- **Integration of countries into international transport corridors, creation of a fundamentally new logistics of the 21st century.**
- **Development of related branches for track structure and rolling stock manufacture (metallurgy, chemical, petrochemical and radio-electronic industries, machine building, construction, etc.).**

PATENTS

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2224064

ТРАНСПОРТНАЯ СИСТЕМА ЮНИЦКОГО (ВАРИАНТЫ) И СПОСОБ ПОСТРОЕНИЯ ТРАНСПОРТНОЙ СИСТЕМЫ

Патентообладатель(ли): *Юницкий Анатолий Эдуардович, Терёхин Дмитрий Владимирович*

Автор(ы): *Юницкий Анатолий Эдуардович*

Заявка № 2002113321
Приоритет изобретения 21 мая 2002 г.
Зарегистрировано в Государственном реестре изобретений Российской Федерации *20 февраля 2004 г.*
Срок действия патента истекает 21 мая 2022 г.

Генеральный директор Российского агентства по патентам и товарным знакам

А.Л. Корчагин

EUIPO
EUROPEAN UNION INTELLECTUAL PROPERTY OFFICE

EUROPEAN UNION INTELLECTUAL PROPERTY OFFICE
CERTIFICATE OF REGISTRATION

This Certificate of Registration is hereby issued for the Registered Community Design identified below. The corresponding entries have been recorded in the Register of Community Designs.

AMT DER EUROPÄISCHEN UNION FÜR GEISTIGES EIGENTUM
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Diese Eintragungsurkunde wird für das unten genannte eingetragene Gemeinschaftsgeschmackmuster ausgestellt. Die entsprechenden Einträge sind in das Register für Gemeinschaftsgeschmacksmuster aufgenommen worden.

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РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2324612

СТРУННАЯ ТРАНСПОРТНАЯ СИСТЕМА ЮНИЦКОГО

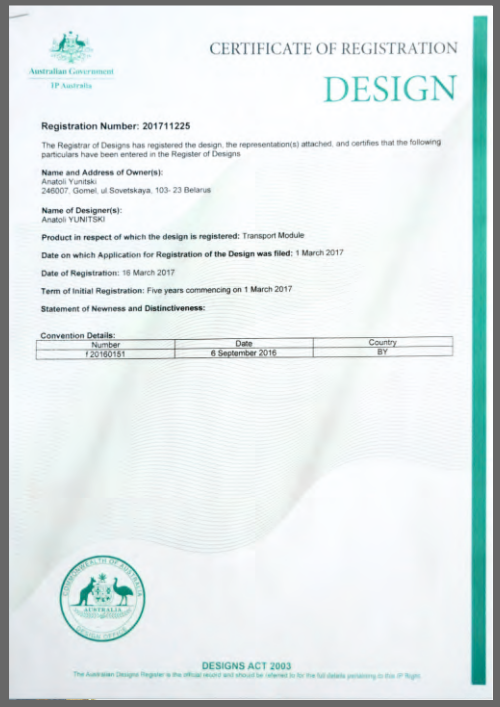
Патентообладатель(ли): *Юницкий Анатолий Эдуардович (RU)*

Автор(ы): *Юницкий Анатолий Эдуардович (RU)*

Заявка № 2006127132
Приоритет изобретения 27 июля 2006 г.
Зарегистрировано в Государственном реестре изобретений Российской Федерации *20 мая 2008 г.*
Срок действия патента истекает 27 июля 2026 г.

Руководитель Федеральной службы по интеллектуальной собственности, патентам и товарным знакам

Б.П. Симонов



Australian Government
IP Australia

CERTIFICATE OF REGISTRATION

DESIGN

Registration Number: 201711225

The Registrar of Designs has registered the design, the representation(s) attached, and certifies that the following particulars have been entered in the Register of Designs

Name and Address of Owner(s):
Anatoli Yuntski
246007, Gomel, ul.Sovetskaya, 103- 23 Belarus

Name of Designer(s):
Anatoli YUNITSKI

Product in respect of which the design is registered: Transport Module

Date on which Application for Registration of the Design was filed: 1 March 2017

Date of Registration: 16 March 2017

Term of Initial Registration: Five years commencing on 1 March 2017

Statement of Newness and Distinctiveness:

Convention Details:

Number	Date	Country
f 20160151	6 September 2016	BY

DESIGNS ACT 2003

РЭСПУБЛІКА БЕЛАРУСЬ

ПАТЭНТ

НА ПРАМЫСЛОВЫ ЎЗОР

№ 3684

Подвижное средство для струнных транспортных систем (2 варианта)

выдадзены
Нацыянальным цэнтрам інтэлектуальнай уласнасці
ў адпаведнасці з Законам Рэспублікі Беларусь
«Аб патэнтах на вынаходствы, карысныя мадэлі, прамысловыя ўзоры»

Патэнтаўладальнік (патэнтаўладальнікі):
Юницкий Анатолий Эдуардович (BY)

Аўтар (аўтары):
Юницкий Анатолий Эдуардович (BY)

Заяўка № f20160118 Дата падачы: 15.07.2016

Зарэгістравана ў Дзяржаўным рэестры прамысловых узораў: 03.10.2016

Дата пачатку дзеяння: 15.07.2016

Генеральны дырэктар П.М. Броўкін

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ

ҰЛТТЫҚ ПАТЕНТ ВЕДОМСТВОСЫ

№ 114

ӨНЕРКӘСІП ҮЛГІСІНЕ БЕРІЛГЕН

АЛДЫН АЛА ПАТЕНТ

AWARDS

GEM INDONESIA

Certificate of Appreciation

GEM INDONESIA
(Subsidiary of GEMISEN GROUP) as an Organizing Committee of

RAILWAYTECH INDONESIA

The Indonesia International Railway Technology, Equipment, Systems & Services Exhibition 2017

29 MARCH - 01 APRIL 2017

JIExpo Kemayoran, Jakarta - Indonesia

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Skyway Technologies Co.

For your participation and support
Chairman of Organizing Committee

Dr. Yenti Wong

AMBASSADOR FOR PEACE

Universal Peace Federation

The Universal Peace Federation acknowledges as Ambassadors for Peace those individuals whose lives exemplify the ideal of living for the sake of others, and who dedicate themselves to practices which promote universal moral values, strong family life, interreligious cooperation, international harmony, renewal of the United Nations, a responsible public media, and the establishment of a culture of peace.

Transcending racial, national and religious barriers, the Ambassadors for Peace contribute to the fulfillment of the hope of all ages, a united world of peace wherein the spiritual and material dimensions of life are harmonized.

The Universal Peace Federation is proud to hereby recognize as an Ambassador for Peace,

Anatoly Yunitskiy

Rev. Dr. Sun Myung Moon, Founder

Dr. Hak Ja Han Moon, Co-Founder

THE INTERNATIONAL ACADEMY FOR INTEGRATION OF SCIENCE AND BUSINESS (IAISB)

Unitskiy Anatoliy Eduardovich

is elected the Full Member of the IAISB

10 August 2011

President of the Academy

Chief Scientific Secretary

МЕЖДУНАРОДНАЯ АКАДЕМИЯ ИНТЕГРАЦИИ НАУКИ И БИЗНЕСА (МАИНБ)

Юницкий Анатолий Эдуардович

избран Действительным членом МАИНБ

10 августа 2011

Президент Академии

Главный ученый секретарь

Национальная Программа продвижения лучших российских товаров, услуг и технологий "Российская Марка"

СВИДЕТЕЛЬСТВО

Лауреата национального конкурса "Российская Марка"

Настоящее свидетельство удостоверяет, что

Технология струнного транспорта

ОАО «Научно-производственная компания Юницкого» (г. Москва)

представленный (ая) на конкурс "Российская Марка", соответствует установленным критериям качества и награждён (а)

ЗОЛОТЫМ ЗНАКОМ КАЧЕСТВА

"РОССИЙСКАЯ МАРКА"

Решение Высшего Совета Знака "Российская Марка" № 14 от 16.10.2001 г.

Председатель Высшего Совета Знака "Российская Марка" А.И. Вольский

Председатель Коллегии главных экспертов А.Г. Овдиенко

Москва

ДИПЛОМ

РАЗУМ ДОБЛЕСТЬ ЧЕСТЬ

РОССИЙСКАЯ АКАДЕМИЯ ЕСТЕСТВЕННЫХ НАУК
ПРИСУЖДАЕТ

Юницкому Анатолию Эдуардовичу

ПОЧЕТНОЕ ЗВАНИЕ И ЗНАК
«РЫЦАРЬ НАУКИ И ИСКУССТВ»

РЕШЕНИЕ ПРЕЗИДИУМА АКАДЕМИИ
№ 129 от 05 декабря 2000 г.

ПРЕЗИДЕНТ

ГЛАВНЫЙ УЧЕНЫЙ СЕКРЕТАРЬ

ЮБИЛЕЙНАЯ МЕЖДУНАРОДНАЯ

ТРАНСПОРТ РОССИИ

30 НОЯБРЯ – 2 ДЕКАБРЯ 2016

ДИПЛОМ

НАГРАЖДАЕТСЯ

ЗАО «СТРУННЫЕ ТЕХНОЛОГИИ»

ЗА

ИННОВАЦИИ В СФЕРЕ ТРАНСПОРТА

Диплом лауреата

в номинации

«Проект года транспортной отрасли»

ООО «Струнный транспорт Юницкого»

Председатель Президиума премии

Заместитель Председателя Государственной Думы Федерального Собрания Российской Федерации

Яров В. А.

Москва 2009

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Minsk, 220116, Republic of Belarus

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