# Innovative Transport and Infrastructure Technologies SkyWay

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# Development of TRANSPORT and INFRASTRUCTURE COMPLEXES SkyWay is carried out by a team of engineers and designers of SkyWay Technologies Co. (Minsk, Belarus)

## Company structure

**General Director**

**General Designer**

- Engineering analysis department
- Department for rolling stock
- Project work department
- Department for safety systems and motion control
- Office for General designer projects
- Department for linear and infrastructural facilities
- Department for infrastructure, accessories and test equipment
- Chief engineer office
- General service department
- Accounting and planning department
- Human resources department
- Business development department
- Legal department
- 15 Design bureaus (over 100 design-engineers)

# Principle of SkyWay Technology

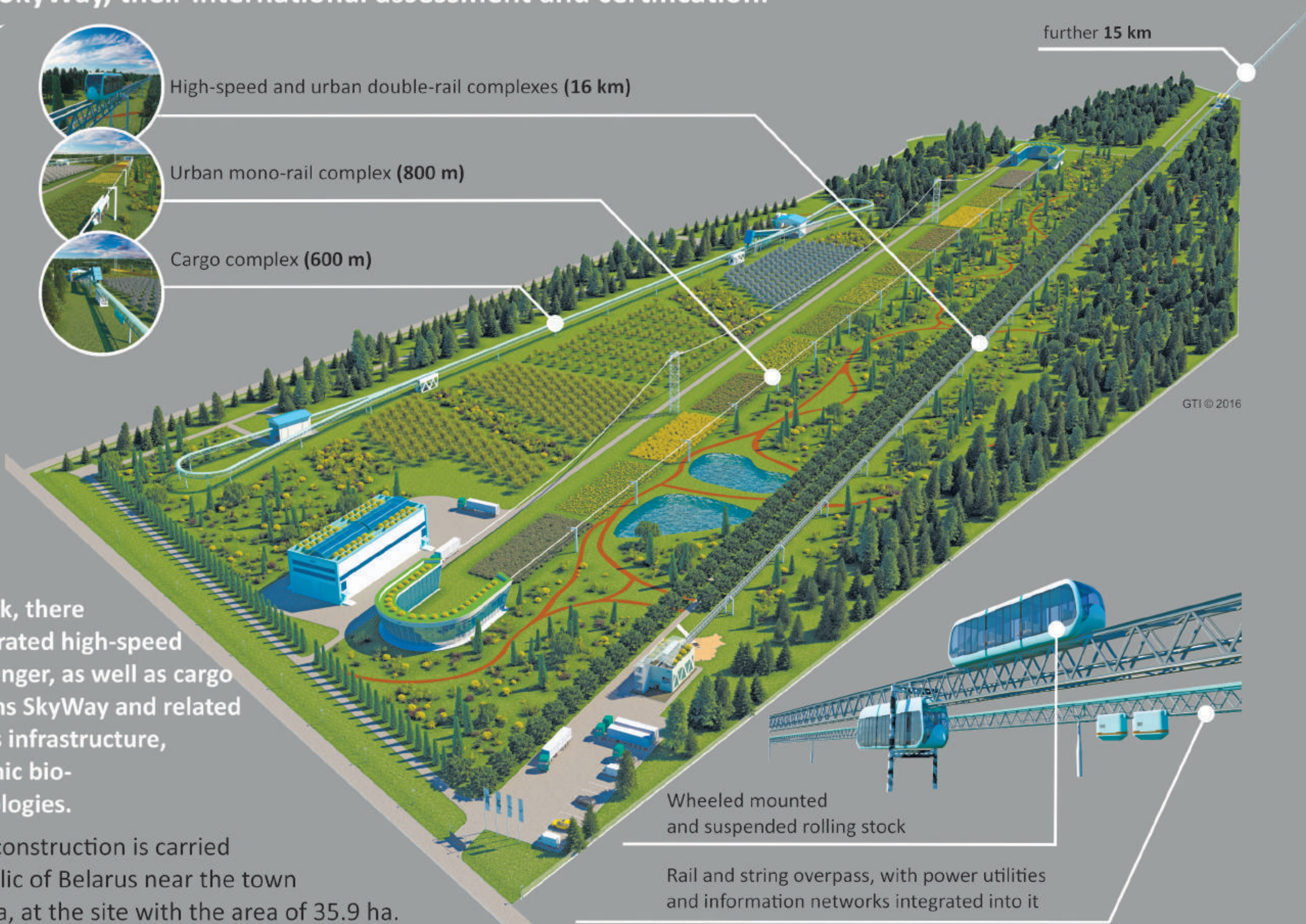


Mounted and suspended wheeled vehicles operate above the ground on the innovative rail and string elevated structure by means of breakthrough transport and communications infrastructure of the "second level".

# Main Project of SkyWay Technologies Co.: EcoTechnoPark

**EcoTechnoPark is a centre for practical implementation of innovative technologies SkyWay, their international assessment and certification.**

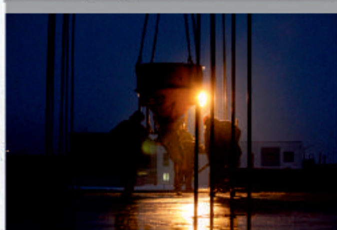
eco TECHNO PARK




**In EcoTechnoPark, there will be demonstrated high-speed and urban passenger, as well as cargo transport systems SkyWay and related communications infrastructure, including ecogenic bio- and agro-technologies.**

**EcoTechnoPark** construction is carried out in the Republic of Belarus near the town of Maryina Gorka, at the site with the area of 35.9 ha.

# Main Project of SkyWay Technologies Co.: EcoTechnoPark

• construction project completed;

• the right to use the land plot obtained, as well as all the required permits to carry out construction works, laying of the mains cable for electricity supply and a water supply line;

• engineering and geodesic surveys for transport elevated structures and mains cables for water and electricity supply completed;

• the process of constructing walls for the first floor and interflooring for the transport node, coupled with a terminal anchor support, finished. 16 out of 18 intermediate overpass supports for urban passenger transport system (acceleration area for high-speed SkyWay) installed.

# Minutes of on-site joint session of the Scientific and Technical Council for the Ministry of Transport of Russia, the Scientific and Technical Council for Transportation of Russia and the inter-agency working group on problems of rapid off-street transport (Ozyory, Moscow Region, April 12, 2002)

"...String transport system can be considered as one of the new promising non-traditional kinds of overground transport, which has previously proved its viability..."

"It is recommended as follows:

- determine the area for string transport functional application;
- carry out calculations and experimental research on stress-strain behaviour of structural elements;
- carry out calculations and experimental research on structural elements reliability (resource);
- conduct additional research on the questions concerning the following:
  - choice of drive types for transport systems;
  - vehicle movement control;
  - provision of track structure rigidity and reliability;
  - provision of rolling stock transverse stability;
  - safety provision for staff, passengers, cargo and the environment."

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.

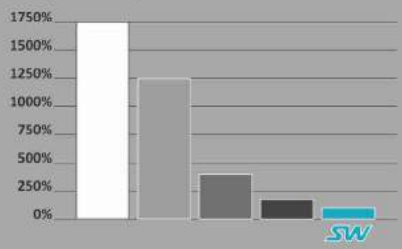
"It is recommended to work out a question on development of a test base."

"It is recommended to carry out in parallel a question on project support and financing."

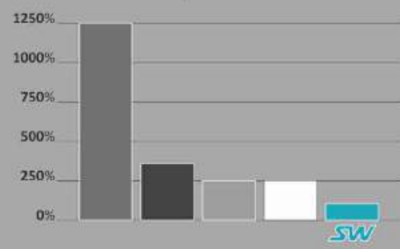
# Main Transport Solutions of Innovative Technology SkyWay

## SkyWay compared to other means of transport

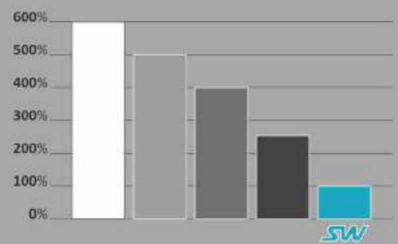
### Capital expenses



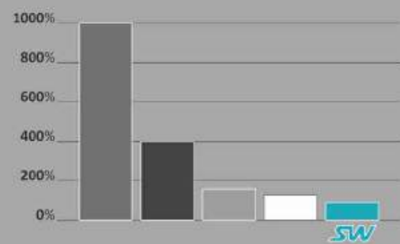

### Environmental pollution




### Operating expenses




### Traffic accident rate




- Magnetic levitation train
- Mono-rail track
- Automobile transport
- Railway transport

String Transport SkyWay

**According to the estimate of the Russian Academy of Sciences, innovative transport technology SkyWay is the most cost-effective, environmentally friendly and safest of all known and advanced transport systems**

## HIGH-SPEED SkyWay (mounted and suspended)


Designed for intercity passenger transportation over long distances **(up to 10,000 km).**

**Energetically highly-efficient, low-noise, safe, eco-friendly.**

*Speed: up to 500 km/h*
*Performance – 500,000 passengers per day and more.*
*Maximum gradient – 20%*

## URBAN SkyWay (mounted and suspended)


Designed for passenger transportation over short distances **(up to 200 km)**. It is harmoniously included into urban development.

**Energetically highly-efficient, low-noise, safe, eco-friendly.**

*Speed: up to 150 km/h*
*Performance – 25,000 passengers per hour and more.*
*Maximum gradient – 45%*

## CARGO SkyWay (mounted and suspended)


Designed for cargo transportation (including on hard-to-reach and underdeveloped territories).

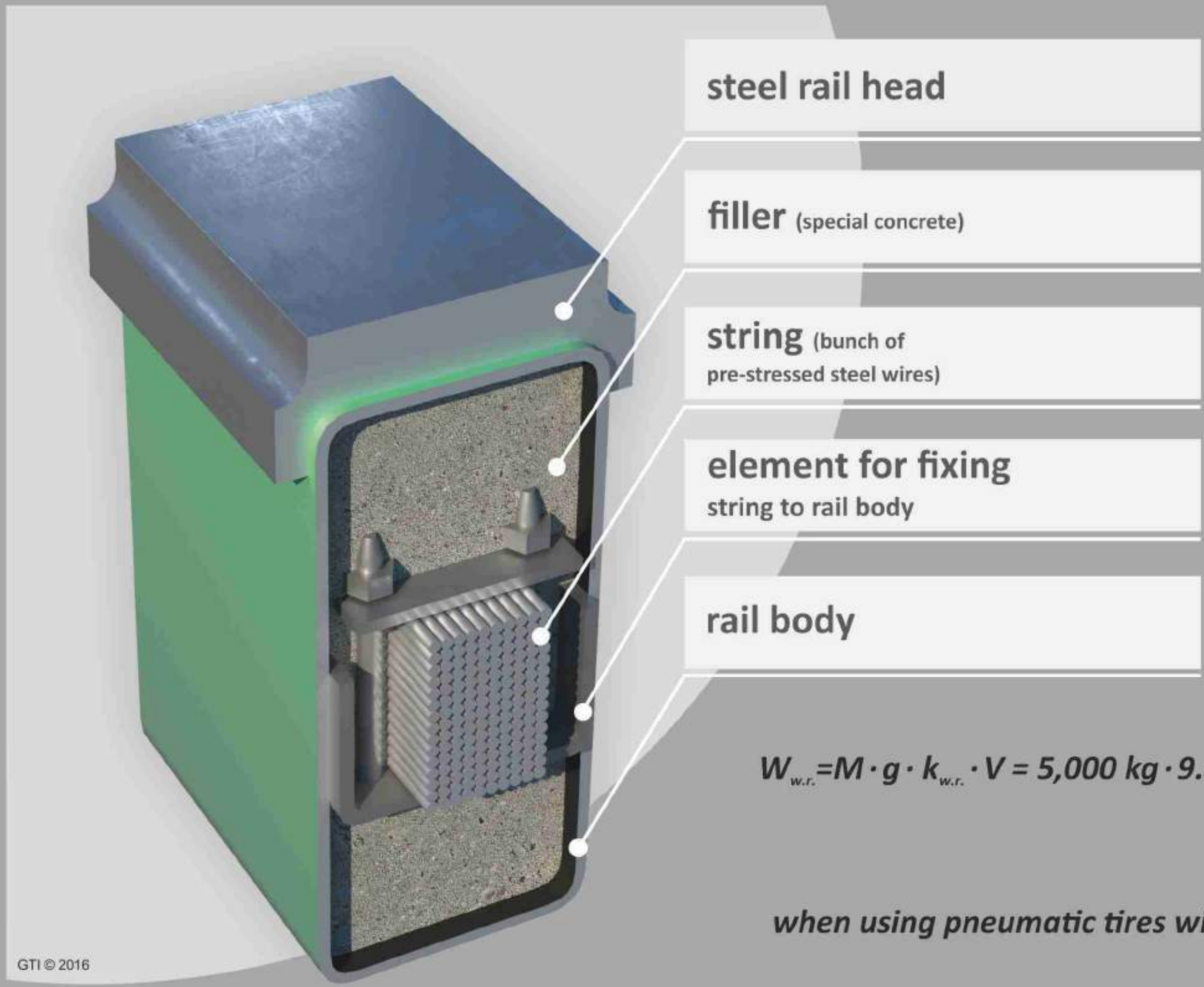
**Energetically highly-efficient, low-noise, safe, eco-friendly.**

*Speed: up to 150 km/h (suspended) and up to 500 km/h (mounted).*
*Performance – 200 mln tons per year and more.*
*Maximum gradient – 60%*

# The Basis of SkyWay technology is Innovative String Rail

## A flat rail head and a cylindrical steel wheel ensure minimal energy consumption for movement

Design variant of a semi-rigid string rail




***Power of unibus wheel rolling resistance with weight of 5,000 kg at the speed of 450 km/h:***

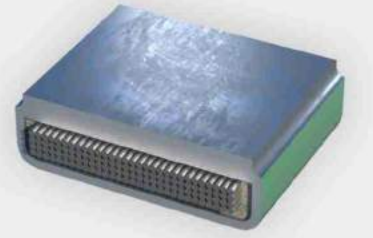
$$W_{w.r.} = M \cdot g \cdot k_{w.r.} \cdot V = 5{,}000\ kg \cdot 9.81\ m/s^2 \cdot 0.0015 \cdot 125 m/s \approx 9.2\ kW$$

***Compare:***

***when using pneumatic tires with $k_{w.r.} = 0.18$ (for V = 450 km/h), $W_{w.r.} \approx 1{,}100\ kW$***

# The Basis of SkyWay technology is Innovative String Rail

## Flexible rail





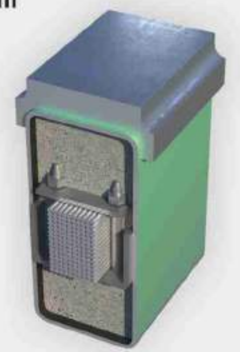
**FLEXIBLE UNCUT TRACK STRUCTURE**

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**


*It is not an analogue to cable railway:*

- *use of rail (lower 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).*

## Semirigid rail

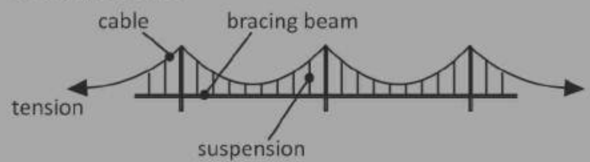




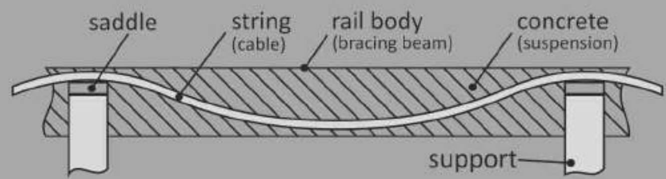
**SEMIRIGID UNCUT TRACK STRUCTURE**

Motion speed: **from 50 up to 150 km/h**
Relative structural rigidity: **1/500–1/2,000**
Track structure curve radius: **R=500...5,000 m**

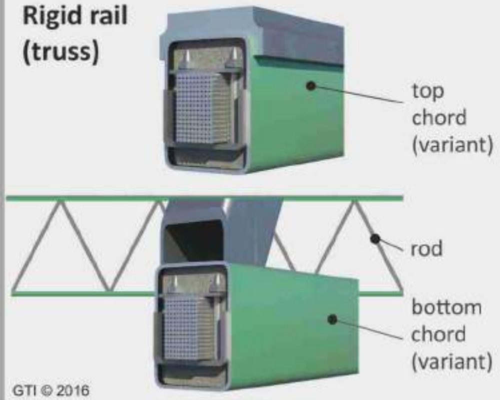
**Hanging bridge:**




*Track structure design follows the design of a hanging bridge, combining its all main elements:*



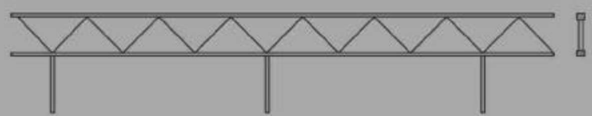

## Rigid rail (truss)






**RIGID UNCUT TRACK STRUCTURE**

Motion speed: **from 100 up to 500 km/h**
Relative structural rigidity: **1/1,000–1/10,000**
Track structure curve radius: **R=5,000...50,000 m**

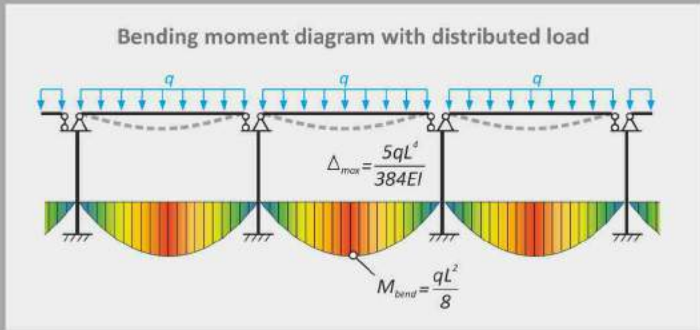


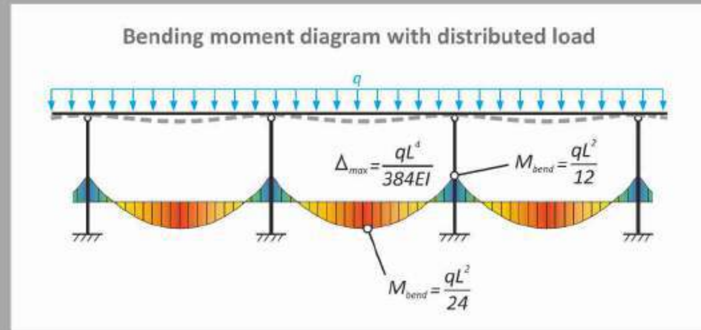
# Types of String Rails and Corresponding Track Structure Designs

# SkyWay Technology and Conventional Beam Overpass

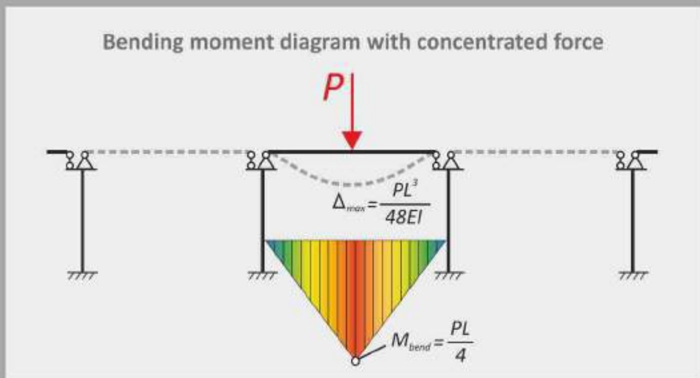
**Split overpass (conventional bridge)**

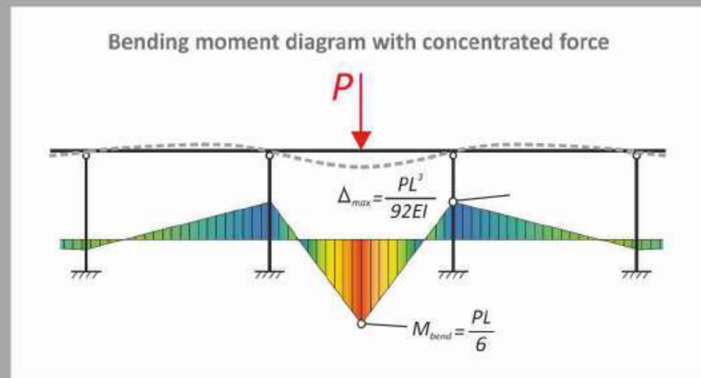
**Innovative uncut pre-stressed overpass (SkyWay technology)**



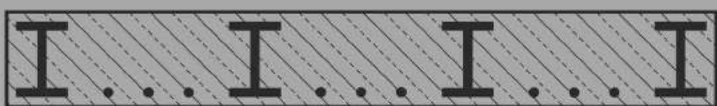




**With equally distributed load, SkyWay overpass is 5 times more rigid (smoother) and 3 times stronger than a conventional bridge**




**With equal concentrated force, SkyWay overpass is twice more rigid (smoother) and 1,5 times stronger than a conventional bridge**



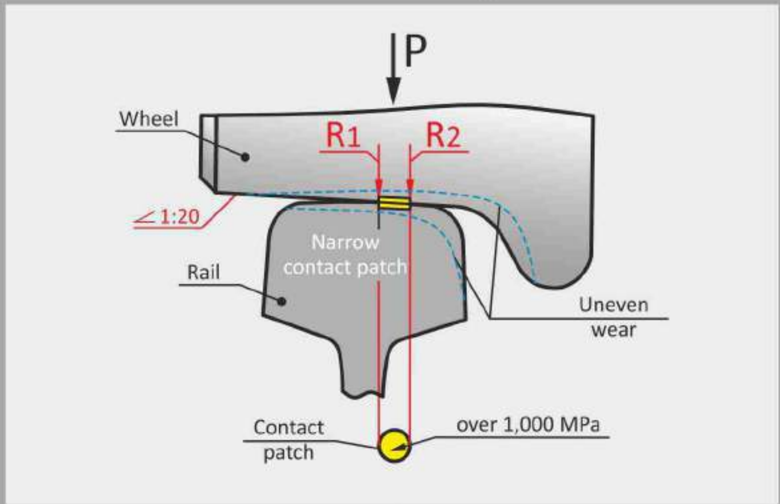
Solid roadbed gives additional load onto supports.
**90%** of load in conventional overpass is **its own weight**.

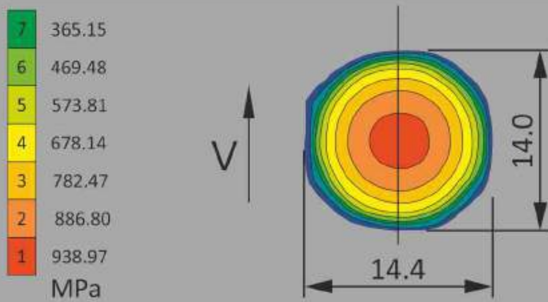
Only **10%** of load in **SkyWay** overpass is **its own weight**.

**SkyWay overpass decreases the amount of building materials and, consequently, reduces the cost by 15 times compared to a conventional overpass**

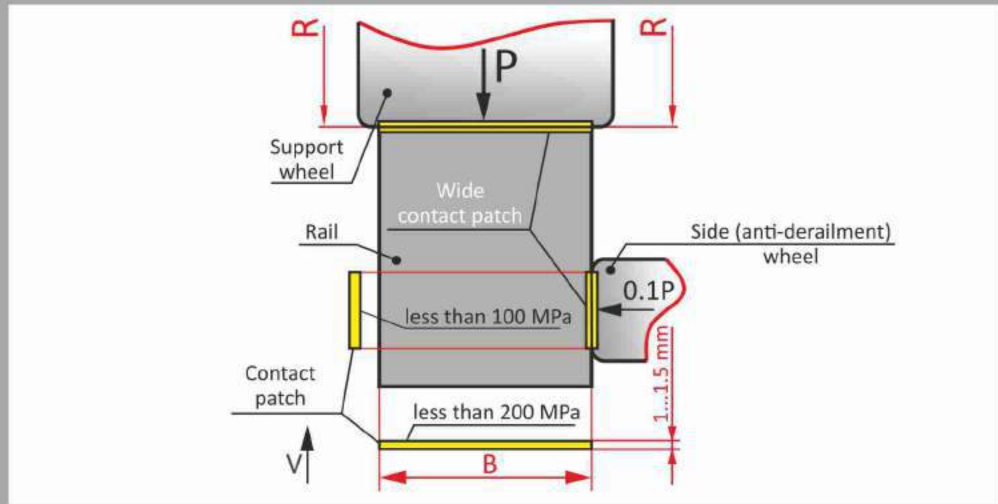
# Advantages of Steel Wheels SkyWay

### Conventional railway wheel




### Innovative unibus wheel




**Calculation of contact stress for high-speed unibus with gross weight of 5 tons**

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

P – wheel load;
E – effective elastic modulus;
B – width of wheel supporting part;
R – wheel radius;
q – coefficient of contact irregularity by length

## Increased wheel wear and noise due to the following:

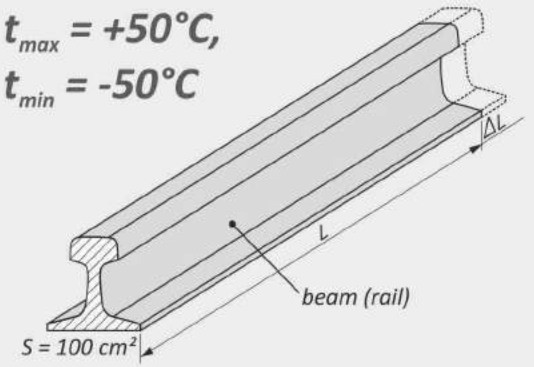
- big contact stresses (1,000 MPa and more), caused by a small size of contact patch;
- slipping in the contact patch, caused by a difference of seating diameters in the conical surface of the wheel;
- operation of brake mechanisms (brake shoes cause additional wheel thread wear);
- big static and dynamic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

## 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, which prevents 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 direction of wheel rolling).**

# Pre-Stressed String Track SkyWay Is the Optimal Solution for Thermal Distortion Compensation

$t_{max}$ = +50°C,
$t_{min}$ = -50°C




**Under thermal effects:**

- absolute deformation

$$\Delta L = \alpha \cdot L \cdot \Delta t$$

- relative deformation

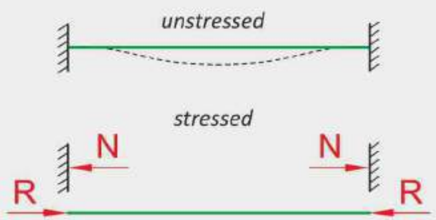
$$\varepsilon = \frac{\Delta L}{L} = \alpha \cdot \Delta t$$

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

$$\alpha = 0.000012$$

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

## Tests of a rigidly restrained beam for strength and stability under thermal effect (Δt = 100°C)




**Test for strength:**

- compression strain of longitudinal fibres:

$$\sigma = E \cdot \varepsilon = E \cdot \alpha \cdot \Delta t \leq \sigma_{02}$$

**For steel, with** $E = 2 \cdot 10^6\ kgf/cm^2$ **and** $\Delta t = 100°C$:

$$\sigma = 2 \cdot 10^6 \cdot 0.0012 = 2{,}400\ kgf/cm^2$$

**Test for stability:**

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

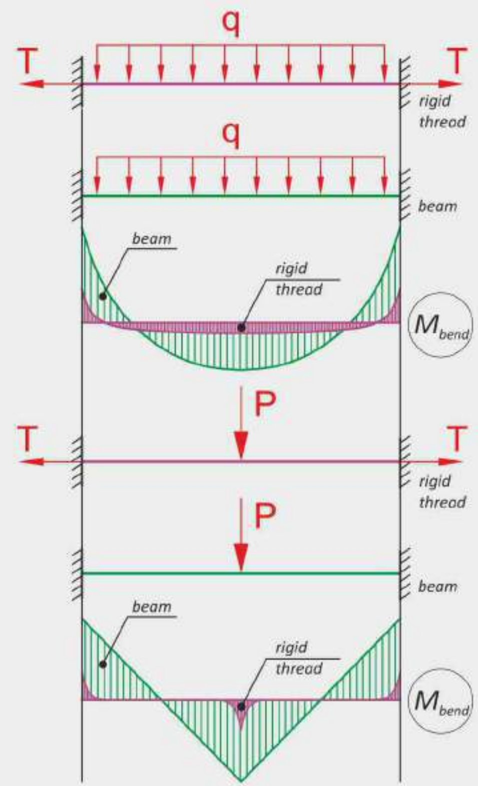
$$N = \sigma \cdot S = E \cdot \alpha \cdot \Delta t \cdot S \leq N_{cr.f.} = \frac{4\pi^2 EI}{L^2}$$

**For steel, with** $S = 100\ cm^2$ **and** $\Delta t = 100°C$:

$$N = 2{,}400 \cdot 100 = 240\ tf$$

*With 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 pre-stressed "rigid thread" and a restrained beam with distributed load and concentrated forces



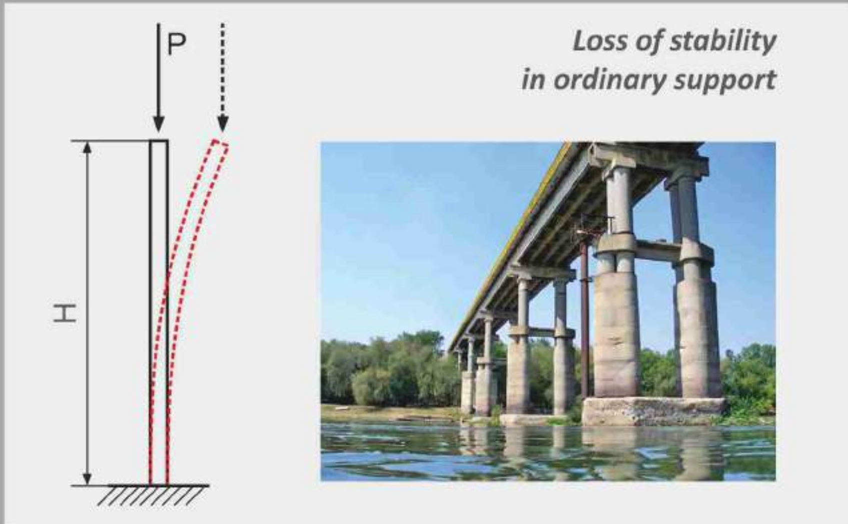

*CONCLUSION: bending stress in a rigid thread is by times lower than in a beam*

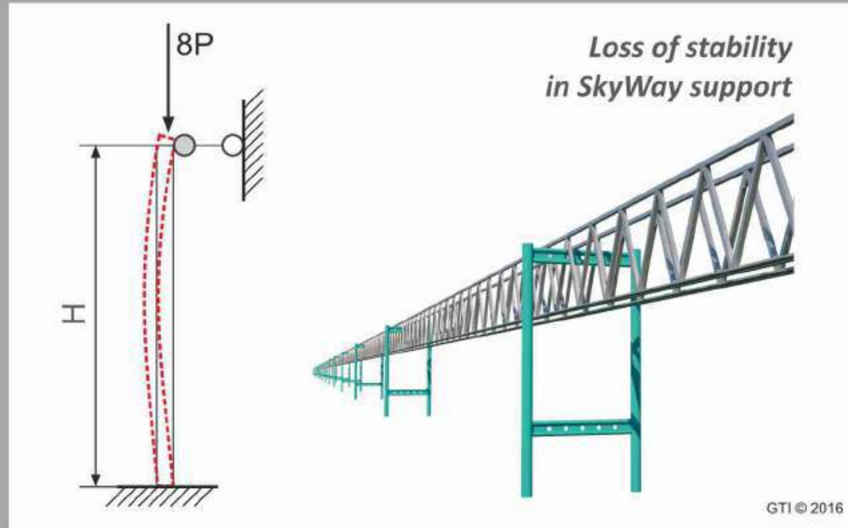
***CONCLUSION: The most dangerous phenomenon when heating a rigidly restrained beam is considered the loss of its stability.***

**SOLUTION:**

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

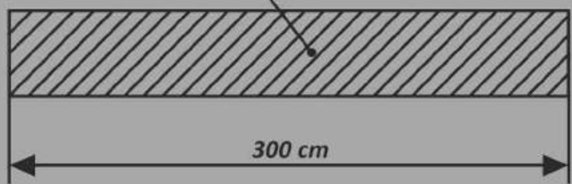
# High Evenness of the Track is Achieved Due to the Uncut Structure of String Rail Between Anchor Supports



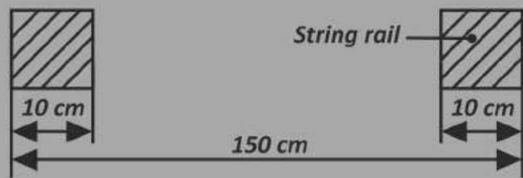




- Intermediate supports installed at a span from 25 up to 100 metres (to ensure rigidity of uncut track structure) allow to use light structures.
- Fixing of support top to the track structure allows to additionally increase its load-bearing capacity by 8 times.
- The amount of materials required for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

*Conventional overpass bed (traffic lane)*




*SkyWay track structure*



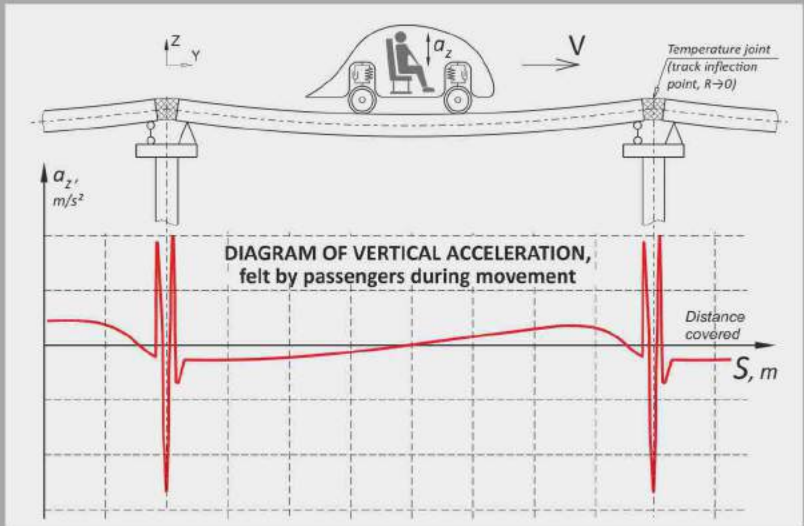

**Compared to a conventional beam overpass, uncut structure of the string rail in its overpass design**
**REDUCES THE AMOUNT OF BUILDING MATERIALS BY 15 TIMES AND MORE**

**Construction cost of a conventional overpass with ordinary supports — from 100 mln USD/km**

**Construction cost of SkyWay overpass — from 3 mln USD/km**

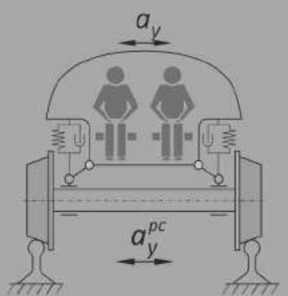
# Smooth Movement

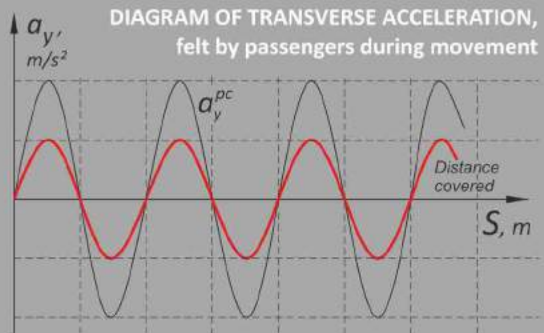
## SPLIT OVERPASS (CONVENTIONAL BRIDGE)



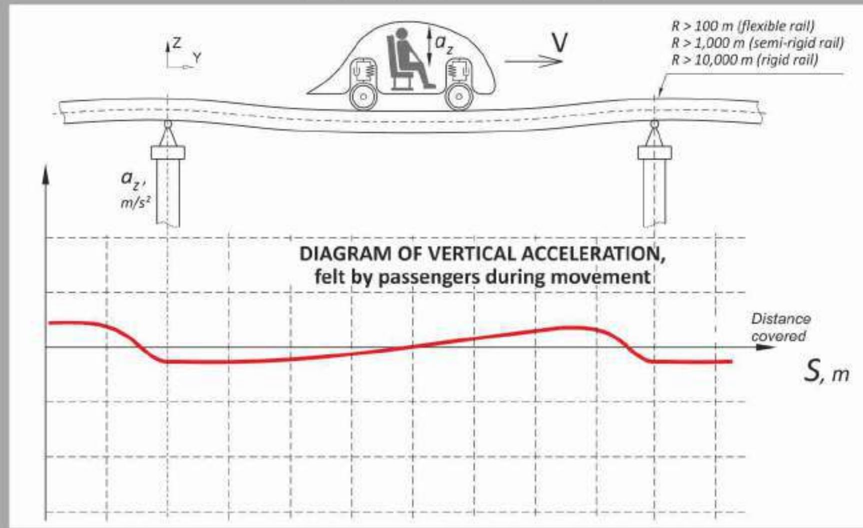

**DISADVANTAGES:**

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



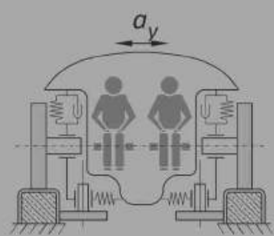



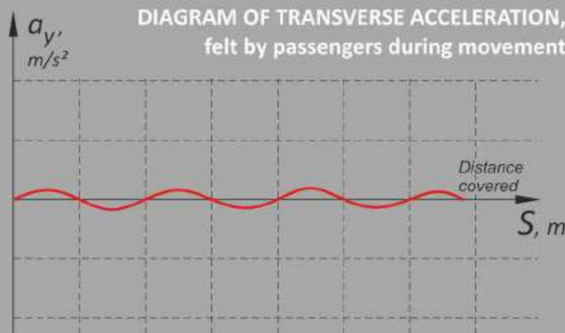

## UNCUT PRE-STRESSED OVERPASS (SkyWay TECHNOLOGY)




**ADVANTAGES:**

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




**Passenger comfort is estimated by smooth movement W (by method of E.Shperling)**

$$W=2.7k\sqrt[10]{T\cdot E}$$

where: $k$ – coefficient, which depends on direction and vibration frequency,
$T$ – intensity of acceleration buildup, i.e. time derivative of acceleration amplitude,
$E$ – maximal kinetic energy, obtained by single mass of a passenger during vibration, which is numerically equal to multiplication of displacement amplitude by acceleration amplitude.

| Evaluation of car movement | Index of smooth movement W |
|---|---|
| Excellent | less than 1 |
| Good | 1–2 |
| Satisfactory (permissible for passengers) | 2–3.25 |
| Permissible for cargo | 3.25–4 |
| Impermissible | 4–5 |
| Unsafe | more than 5 |

# Aerodynamics of a Wheeled Vehicle

## Wind tunnel tests of innovative rolling stock SkyWay (unibus) have given the RESULT: $C_x$= 0.075

This provides saving of drive power in one vehicle SkyWay of about 600 kW compared to the most advanced alternative ground vehicles, which have $C_x$ = 0.2 (for example, a sports automobile $C_x$ = 0.3...0.4)

**At present, SkyWay rolling stock $C_x$ has been improved up to 0.05**

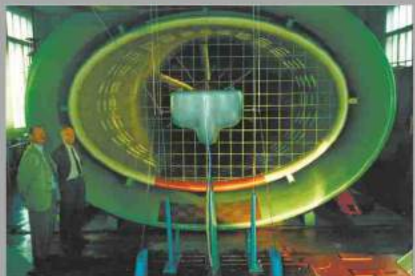
$$\Delta C_x^{min}=0.2-0.05=0.15$$

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

$$\Delta W_{a.r}=\frac{1}{2}\rho_{air}\cdot V^3\cdot \Delta C_x\cdot f_m\cdot k=\frac{1}{2}\cdot 1.25kg/m^3\cdot(125m/s)^3\cdot 0.15\cdot 3m^2\cdot 1.1\approx 600{,}000kW = 600kW$$

Energy (fuel) saving by one unibus (in terms of diesel fuel based on 0.25 l/kW x h) will be as follows:

**600kW x 0.25 l/kW x h = 150 l/h x 20 h = 3,000 l/day x 365 ≈ 1.1 mln l/year x 25 years (unibus life cycle) = 27.5 mln l ≈ 22,000 t/25 years, at the cost of about 20 mln USD**

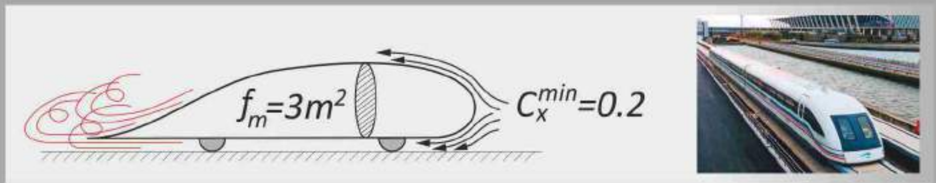


**For 25 years (average operation period of one vehicle), this will give saving for 1 mln unibuses (for example, nowadays there operate about 1 bln automobiles in the world): 22 bln tonnes of fuel at the cost of about 20 trillion USD. In addition, 75 bln tons of oxygen will not be burnt out of the Earth's biosphere.**

Track structure location above the ground and absence of a solid roadbed help to eliminate the main problem for high-speed transport – **aerofoil effect**

**This alone allows to improve vehicle aerodynamics twofold**

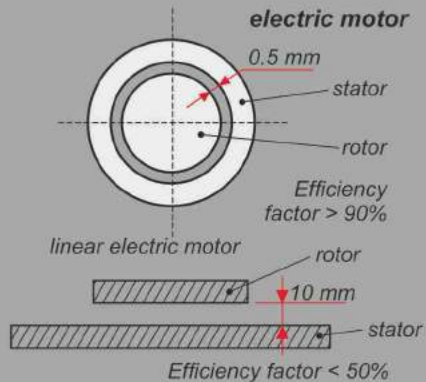
***(Compare: with $C_x$ = 0.3, as for example in sports car Bugatti Veyron, $C_{a.r}^{450}$ ≈ 1,200 kW)***



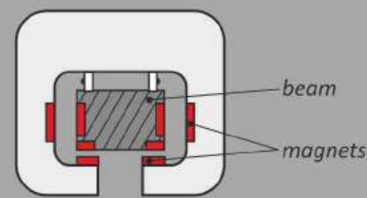

# Advantages of High-Speed SkyWay Over Magnetic Levitation Train

## Magnetic levitation train

Application of linear electric motor gives **efficiency factor not more than 50%** as the clearance between rotor and stator (for example, in Transrapid) cannot be less than 10 mm, and for an electric motor, this clearance shall not exceed 0.5 mm.

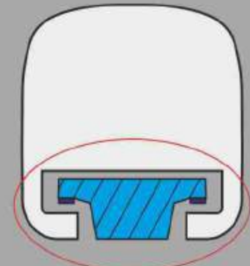



The track structure is expensive as it has a massive roadbed, requires installation of electric coils and a complicated anti-derailment system.



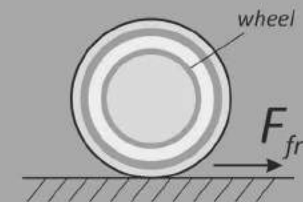

**Overpass cost — from 50 mln $/km**

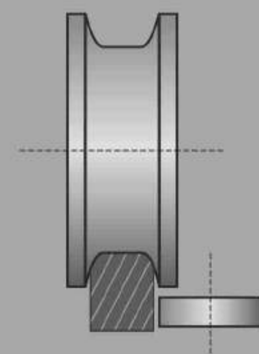
Track structure operation is more labour-consuming as it has a complicated form and includes complicated technical components (electric coils, switching devices, etc.), which require constant maintenance and machinery for cleaning the track from snow and icing.



## High-speed SkyWay

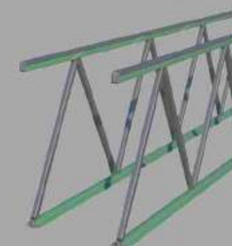
Application of steel wheel ensures **efficiency factor over 99.8%**



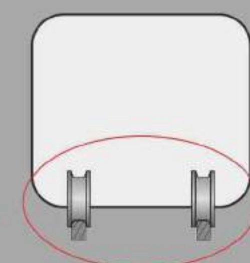



Track structure **SkyWay** is lighter and more cost-effective as it has a delicate roadbed, it does not require installation of electric coils and provides a simple anti-derailment system.

**Overpass cost — from 3 mln $/km**

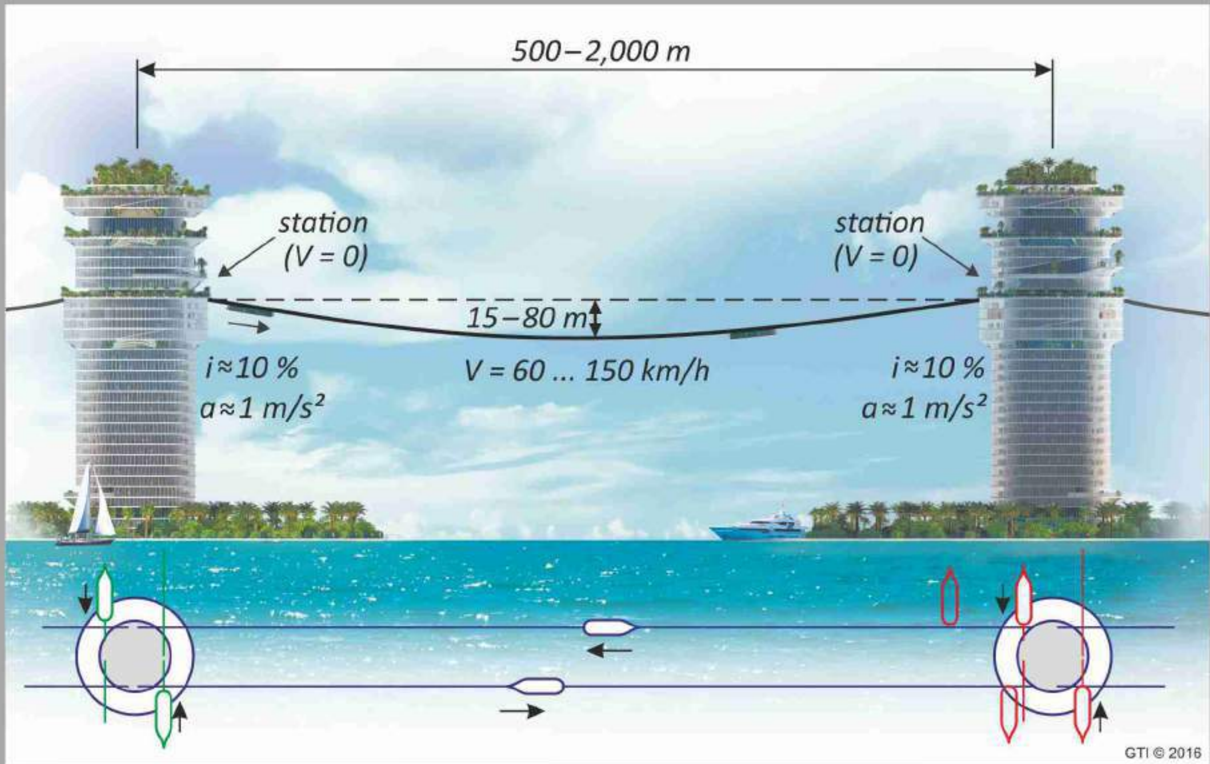


Track structure operation does not require any additional machinery, as it is capable of self-cleaning (for example, from snow and icing) and it has no complicated technical elements (electric coils and others).



# Application of Energy Conservation Law in Innovative Transport SkyWay

## 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




It is explained by the fact that on a downhill section of the track, the unibus does not need an engine — it is accelerated by gravity ("gravity" engine).

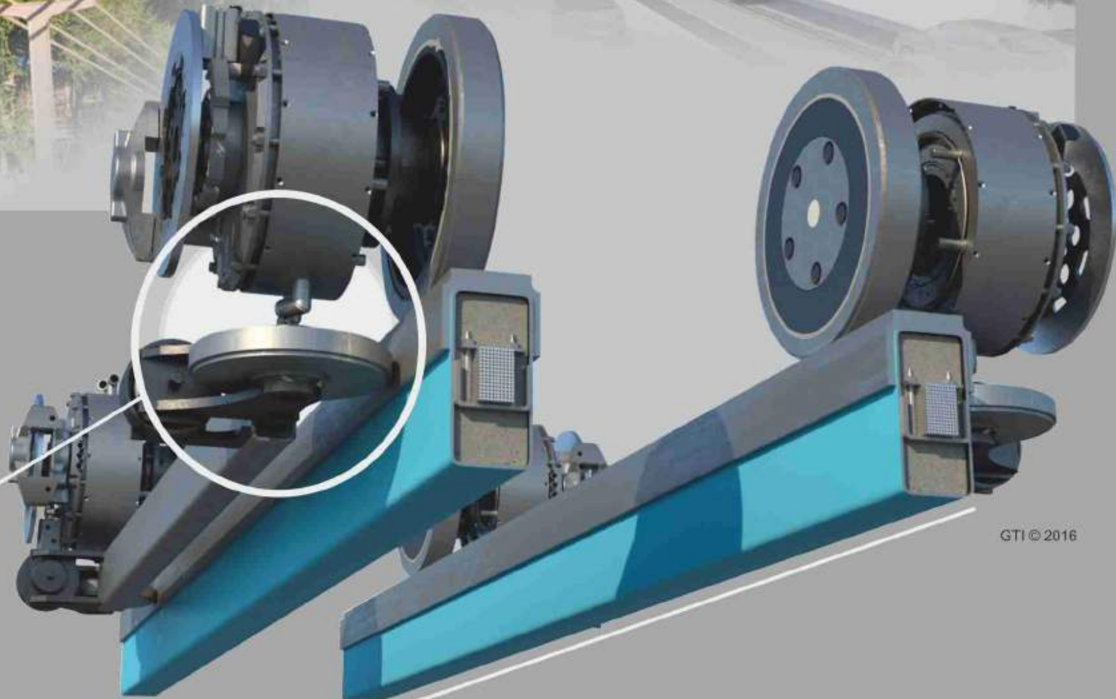
On an uphill section, the unibus does not need brakes — it is slowed down by gravity ("gravity" brake).

Energy recuperation takes place without using a recuperator, as in this case there are applied laws of physics, not any mechanisms.

**Efficiency factor of this recuperation is 100%.**

**The drive in such transport system is only required for aerodynamic compensation, and to overcome steel wheels rolling resistance on a steel rail (in total, about 10 kW for a 50-seat vehicle).**

# Safety of SkyWay Transport Systems



High resistance to vandalism and acts of terrorism

Anti-derailment system increases traffic safety by another 10 times

Location of track structure above the ground enhances safety of movement by about 100 times

# SkyWay Eco-Friendliness


water

there is no earth embankment (low-pressure dam)

minimal local land acquisition (by times)

preservation of natural ecosystems and geobiocenosis

reduced amount of hazardous emissions into the atmosphere (by times) due to less energy consumption

increased noise-, vibro- and electrical safety (by times)

resource consumption — saving of raw materials, land, energy, labour and finances

# Passenger Unibus SkyWay. Chassis Layout

# Control Systems of SkyWay Transport Complex

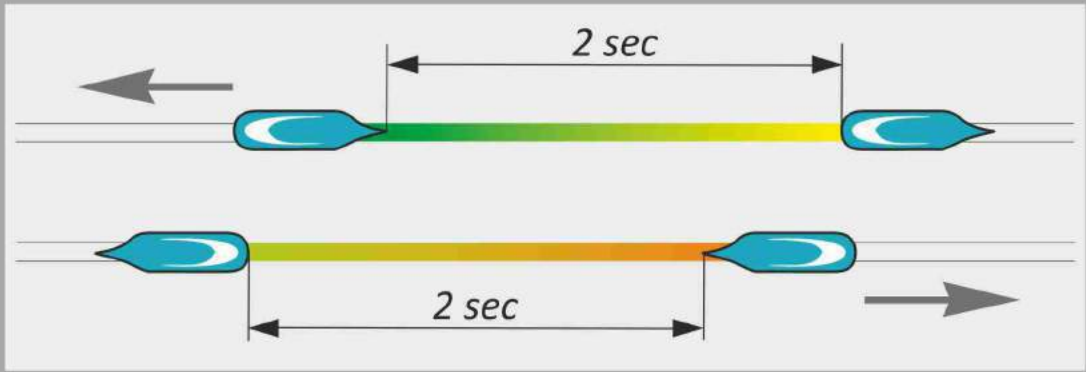
Automated control systems of SkyWay transport complex

Control system of SkyWay transport complex comprises a wide range of wireless and wired communications created on the basis of conventional informational and electronic technologies


Implementation of this system will increase efficiency of traffic control, reduce non-productive cost of goods and passengers transportation, accelerate development of information structure

- System of electrooptic and radioelectronic observation
- Power supply system
- Functional equipment control system
- Safety system
- Position control system
- Data transmission system
- Action information system
- Interworking interface for users
- Propulsion system

# Transportation Capacity of Innovative SkyWay Transport System




**For real-time control systems, a safe time interval between unibuses is 2 sec.**

The indicated requirements are recommended by the American organization Automated People Mover (APM) Standards Committee:

**APM standard part 1 ASCE 21-05** – Operating environment, safety requirements, system dependability, automatic train control, audio and visual communications.

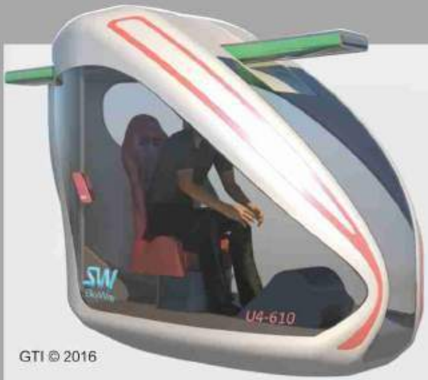
**APM standard part 2 ASCE 21-98** – Vehicles, propulsion and braking.

**APM standard part 3 ASCE 21-00** – Electrical equipment, stations, guideways.

**With the permitted interval of 2 sec. and accounting for the basic capacity of a single module — 10 people — it is possible to ensure the peak traffic capacity of SkyWay transport system at 360,000 people per day in one direction (at 20-hour operation).**

**For bidirectional system, the peak traffic capacity is 720,000 people per day.**
**SkyWay efficiency may be raised by increasing modules capacity and uniting them in trains.**

# Model Range of Lightweight Innovative Passenger SkyWay Vehicles. Unibikes




## UniBike U4-610

**Single-seat unibike**

Number of passengers – 1

Total weight – 300 kg


## UniBike U-61B

**Single-seat unibike with bicycle generator**

Number of passengers – 1

Total weight – 325 kg


## UniBike U4-620

**Double-seat unibike**

Number of passengers – 2

Total weight – 480 kg


## UniBike U-62B

**Double-seat unibike with bicycle generator**

Number of passengers – 2

Total weight – 500 kg

## UniBike U4-630

**Three-seat unibike**

Number of passengers – 3

Total weight – 580 kg


A unibike is a minimized suspended vehicle on steel wheels with the option of motion from muscle power of passengers, in addition to on-board (and external) power sources.

It combines the features of a transport system with a sports and entertainment object. Maximal motion speed is 120 km/h. As a result, one can quickly travel around a city.

# Model Range of Innovative Urban Passenger SkyWay Vehicles

*Large-sized double-rail*

## Articulated UniBus Tandem U4-22T3




Number of passengers – 168
Total weight – 28,000 kg
Unladen weight – 15,400 kg

*Passengers total weight – 12,600 kg*
*Maximum speed – 150 km/h*
*Overall length L – 20,930 mm*
*Distance between module axes B – 3,085 mm*

## Articulated UniBus Tandem U4-26T3




Number of passengers – 84
Total weight – 19,750 kg
Unladen weight – 13,450 kg

*Passengers total weight – 6,300 kg*
*Maximum speed – 150 km/h*
*Overall length L – 18,380 mm*
*Distance between module axes B – 2,830 mm*

## UniBus U4-220




Number of passengers – 28
Passengers accommodation – 8 sitting, 20 standing

*Total weight – 5,000 kg*
*Unladen weight – 2,900 kg*
*Passengers total weight – 2,100 kg*
*Maximum speed – 150 km/h*

## UniBus U4-260




Number of passengers – 14
Passengers accommodation – 4 sitting, 10 standing

*Total weight – 3,500 kg*
*Unladen weight – 2,450 kg*
*Passengers total weight – 1,050 kg*
*Maximum speed – 150 km/h*

## UniBus U4-221




Number of passengers – 7
Passengers accommodation – sitting and in a wheelchair

*Total weight – 3,440 kg*
*Unladen weight – 2,900 kg*
*Passengers total weight – 540 kg*
*Maximum speed – 150 km/h*

**According to SkyWay technology, the innovative urban vehicle has a principle of modular construction for nodal solutions and the structure of rail unibus itself, as well as operatorless control on the route based on software control on the autopilot principle.**

**The principle of unibus modularity gives a customer a possibility to choose the optimal rolling stock at minimum cost.**

# Model Range of Innovative Urban Passenger SkyWay Vehicles

## *Mid-sized monorail*

### UniBus U4-210


Number of passengers – 14
Passengers accommodation – 4 sitting, 10 standing

*Total weight – 3,500 kg*
*Unladen weight – 2,450 kg*
*Passengers total weight – 1,050 kg*
*Maximum speed – 150 km/h*

### UniBus U4-211


Number of passengers – 3
Passengers accommodation – sitting and in a wheelchair

*Total weight – 2,690 kg*
*Unladen weight – 2,450 kg*
*Passengers total weight – 240 kg*
*Maximum speed – 150 km/h*

### Articulated UniBus Tandem U4-21T6


Number of passengers – 84
Total weight – 19,750 kg
Unladen weight – 13,450 kg

*Passengers total weight – 6,300 kg*
*Maximum speed – 150 km/h*
*Overall length L – 18,380 mm*
*Distance between module axes B – 2,830 mm*

## *Small-sized monorail*

### UniCar U4-410


Number of passengers – 3
Passengers accommodation – sitting, single-seat row

*Total weight – 500 kg*
*Unladen weight – 275 кg*
*Passengers total weight – 225 kg*
*Maximum speed – 120 km/h*

### UniCar U4-411


Number of passengers – 2
Passengers accommodation – sitting, opposite row is single-seat

*Total weight – 425 kg*
*Unladen weight – 275 kg*
*Passengers total weight – 150 kg*
*Maximum speed – 120 km/h*

### UniCar U4-420


Number of passengers – 6
Passengers accommodation – sitting, double-seat row

*Total weight – 950 kg*
*Unladen weight – 500 kg*
*Passengers total weight – 450 kg*
*Maximum speed – 120 km/h*

### UniCar U4-421


Number of passengers – 4
Passengers accommodation – sitting, double-seat row

*Total weight – 800 kg*
*Unladen weight – 500 kg*
*Passengers total weight – 300 kg*
*Maximum speed – 120 km/h*

# Model Range of Innovative High-Speed Intercity Passenger SkyWay Vehicles

## Unibus U4-361

High-speed
Double-rail
Mounted
Single-row

Number of passengers – 4
Cargo capacity – 400 kg
Total weight – 2,000 kg
Unladen weight – 1,600 kg
Maximum speed – 450 km/h




## Unibus U4-365

High-speed
Double-rail
Mounted
Double-row with an aisle and a lavatory

Number of passengers – 8
Cargo capacity – 800 kg
Total weight – 5,000 kg
Unladen weight – 4,200 kg
Maximum speed – 450 km/h




## Unibus U4-362

High-speed
Double-rail
Mounted
Double-row

Number of passengers – 8
Cargo capacity – 800 kg
Total weight – 3,500 kg
Unladen weight – 2,700 kg
Maximum speed – 450 km/h




## Unibus U4-365T

High-speed train
Double-rail
Mounted
Double-row with an aisle and a lavatory

Number of passengers – 24
Cargo capacity – 2,400 kg
Total weight – 15,000 kg
Unladen weight – 12,600 kg
Maximum speed – 450 km/h




## Unibus U4-363

High-speed
Double-rail
Mounted
Three-row

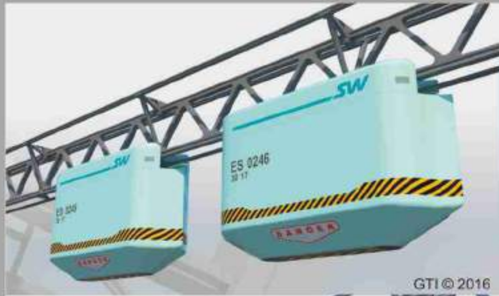
Number of passengers – 12
Cargo capacity – 1,200 kg
Total weight – 5,000 kg
Unladen weight – 3,800 kg
Maximum speed – 450 km/h




**A high-speed unibus is a mounted vehicle on steel wheels allowing to move quickly to a distance of up to 10,000 km. Driving at a high speed is ensured due to special design of track structure and low aerodynamic resistance of the vehicle.**

**The maximum motion speed will be up to 500 km/h, as a result of which a high-speed unibus is ideal for intercity transportation.**

# Model Range of Innovative Cargo SkyWay Vehicles




## UniTruck U4-131

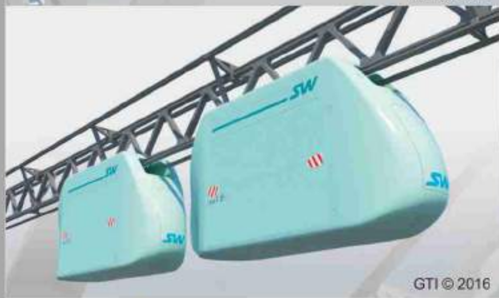
**Single cargo vehicle**
*(mono-rail, suspended)*

*Cargo unitruck for bulk cargo transportation.*
*Total weight – 2,500 kg*
*Section capacity – 0.75 m³*
*Performance – up to 200 mln t/year*


## UniTruck U4-133

**Single cargo vehicle**
*(mono-rail, suspended)*

*Cargo unitruck for liquid cargo transportation.*
*Total weight – 2,500 kg*
*Section capacity – 1 m³*
*Performance – up to 200 mln t/year*




## UniTruck U4-137

**Single cargo vehicle**
*(mono-rail, suspended)*

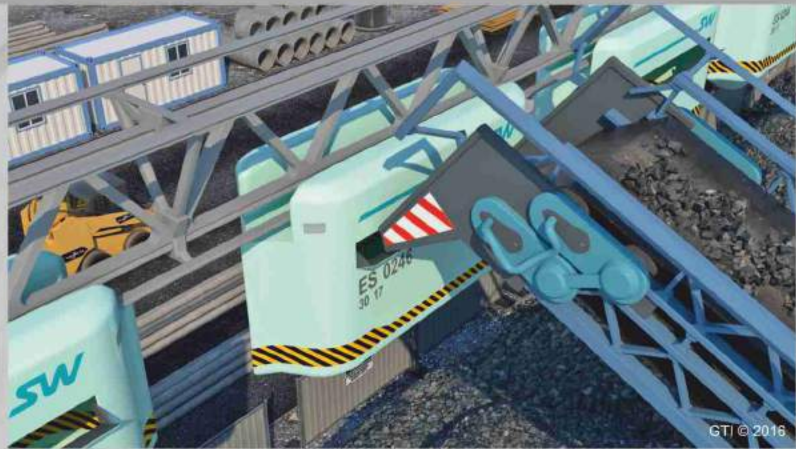
*Cargo unitruck for break-bulk cargo transportation (Europallets, pallets).*
*Total weight - 2,500 kg*
*Section capacity – 2 m³*
*Performance – up to 200 mln t/year*


## UniTrans U4-100

**Loop conveyor (transporter) on wheel pairs with a turn in horizontal plane.**

*Performance – up to 200 mln t/year*

*Cargo SkyWay and cargo vehicle – unitruck*




**A cargo rolling stock will be made on the basis of suspended urban passenger unibuses. Consequently, the maximal weight, speed and bogie are completely unified with passenger transport. A cargo unicar body can have the following modifications: for break-bulk cargo (Europallets), for bulk and liquid cargo.**

# International Recognition of SkyWay


Skyway Urban Track Infrastructure

Skyway Urban Track Infrastructure


Our Company cooperates with Australian company "Rod Hook and Associates" (http://www.rodhook.com.au), headed by former Chief Executive of the Department of Planning, Transport and Infrastructure of South Australia, Mr Rod Hook.

The aim of cooperation is promotion of the technology and obtaining commercial orders for construction of string tracks on the territory of Australia (cargo, port and passenger transportation).

Australian constructing and property consultancy MBMpl PTY Ltd (http://www.mbmpl.com.au/about-us) has carried out SkyWay technology assessment and has confirmed a manifold lower cost for the proposed technology compared to its conventional analogues.

# Implementation of Target Projects in Australia

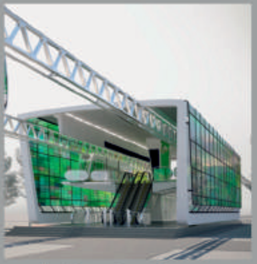
- The first target project of urban track SkyWay in Australia is planned for implementation on the territory of Flinders University (Adelaide, South Australia).
- The track will connect Flinders Medical Center (the existing car park) with the hub of Bedford Park Campus at University. The track length is about 500 m.
- The estimated amount of investment into the project is about 13 mln AUD. The construction is planned to be funded by private investors.
- In prospect, it is proposed to extend the existing railway line from Tonsley station to Flinders Medical Center, which will contribute to the increase in the expected passenger flow.
- The track will not only address the practical needs, but will also become a local attraction, as well as will confirm the innovative status of Flinders University.
- After successful project implementation at Flinders University, it is expected to start implementation of freight, urban and inter-city high-speed tracks SkyWay in all regions of Australia.


# Prospects for SkyWay Technology Application


Track structure

Rolling stock

Automatic Control Systems



Infrastructure

- Exploration and development of underdeveloped and hard-to-reach territories, creation of a single network for cargo, urban and high-speed inter-city tracks.
- Maximal reduction of capital and operating expenses for transport and infrastructure construction.
- Qualitative change in the economic order and increase in countries' 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, mechanic engineering, construction, etc.).

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

# Our Competitors

HYPERLOOP


skyTran

## Hyperloop

The technology of high-speed transport system, developed by American billionaire Elon Musk, the founder of companies Space X and Tesla Motors; according to it, movement is carried out on an air cushion in a vacuum tube.

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

## SkyTran

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

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

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