Brief description of STU

1. Definition of STU

String Transport Unitsky (STU) is the innovative transportation system of “the second level” having the worldwide novelty and the international patent support. It is designed as the original string-rail track structure with a special rolling stock made up of single self-propelled rail cars installed on the steel wheels (unibuses).

STU is represented by the following two principally different transportation systems.

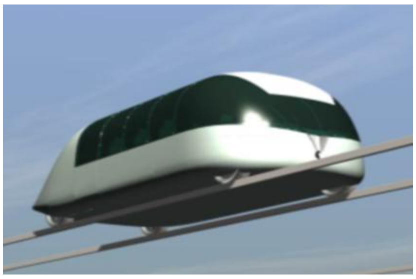
1.1. Double-rail STU

Its track structure is designed as two string-rail stretched with the total strength of 100—600 tons between the anchor supports installed with the intervals between them ranging from 1 to 3 km and based on the intermediate supporting masts having the spans of 20—50 m and more. Cross-sectional dimensions of a string-rail are close to those of a railway rail and in terms of its metal consumption it is less material-intensive than a traditional rail. Design tension of strings depends on the estimated mass of a unibus and the design travel speed as well as on the accepted span length. The string sag at each span is enclosed inside the rail body and the rail head is located with the structural elevation of 10—50 mm in the centre of a span which ensures the highly smooth movement of cars both in the middle of a span and above the supports. In this case a string-rail is designed so that in combination with the design string tension and flexural rigidity of a rail to ensure the following vertical radii of a rail curvature under the impact of the unibuses wheels along the whole length of a STU route irrespective of weather and climatic conditions: not less than 500 m, 5,000 m and 10,000 m for the travel speeds up to 100 km/hour, 350 km/hour and 500 km/hour, respectively. Therefore, it eliminates the wheels “jumping” both in the middle of the spans and above the supports within the whole range of the design travel speeds.

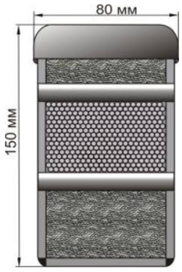
Double-rail STU routes could be designed as single-, double- or multi-track roads to serve for passenger, freight or passenger/freight trips.

The rolling stock consists of single self-propelled cars — unibuses — that are moving above the string-rail on the steel wheels with the travel speeds up to 50—500 km/hour depending on the travel speeds accepted for the given STU route. Admissible travel speed will depend on the rigidity and smoothness of a string-rail track (which is specially designed for the required mass of unibuses and their design travel speed), engine power and aerodynamic qualities of a unibus bode (specially designed for the estimated travel speed). In terms of fuel (energy) consumption STU is 1.5—2 times more efficient than a railway and 3—5 times better than an automobile.

Double-track
double-rail STU in a city



High-speed unibus



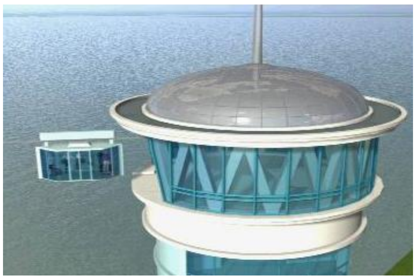
Design alternative of a string-rail
for a span of 30 m

1.2. MonoSTU (single-rail STU)

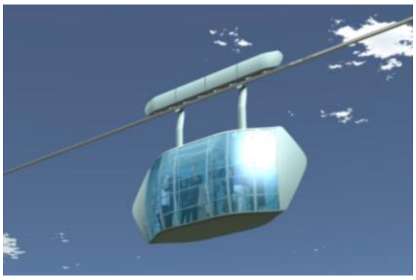
Its track structure is designed as one string-rail stretched with the strength of 50—200 tons between the anchor supports (specially designed buildings could serve as anchor supports) without or with the intermediate supports. Supports could be installed with the intervals of 100—3,000 m from each other[1]. A string-rail track structure is characterized by the extremely low material consumption so that, for example, the amount of materials used for one railway rail R75 is enough to build 2 double-track monoSTU routes of a similar length and in this case the length of spans will be 1—2 km and more instead of 0.6—0.8 m (distance between the railway sleepers).

A string-rail is installed between the adjacent supports with a sag of 0.5—50 m depending on the span length, the string-rail mass and the string tension.

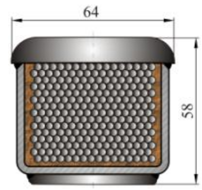
The rolling stock consists of single self-propelled rail cars[2] (mono-unibuses) hanged on the steel wheels under the string-rail and moving with the speeds ranging from 50 to 150 km/hour.



Building-station of monoSTU



40-seat mono-unibus



Design alternative of a mono-rail-string for a span of 2 km

The structural sag of a monoSTU track structure at each large span makes it possible to use the gravitation to accelerate unibuses up to 50—150 km/hour at the beginning of a trip and to decelerate for braking at the second part of a trip. Therefore for the citywide circulation cycle (with stops every 0.5—2 km) monoSTU is characterized by the unprecedented low drive power and, consequently, low fuel (electric energy) consumption enabling high design travel speeds. In terms of its fuel (energy) efficiency monoSTU has no equal among other known and prospect transportation systems. For example, energy (fuel) consumption for the citywide circulation at the travel speed of 100 km/hour is 0.6—0.8 kWt×hour of electric energy per 100 passenger-km or 0.15—0.2 liter of fuel per 100 passenger-km.

MonoSTU routes could be designed as single-, double- or multi-track roads to serve for passenger, freight or passenger/freight trips.

2. Key novelty features of STU

2.1. Structural novelty of STU

The structural novelty of STU is associated with the original design of a pre-stressed string-rail elevated road. It makes it possible to design a practically ideal, even and rigid rail track eliminating

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1 Anchor supports (buildings) of a track structure installed one after another in the necessary direction make it possible to build STU routes of unlimited length with the required c turns. Changes in the route directions are facilitated on the anchor supports that are also suitable to accommodate passenger stations or cargo terminals.

2 Self-propelled rail cars — STU unibuses and mono-unibuses — could serve as passenger, freight or universal dual-mode (passenger/freight) vehicles of various carrying capacity and comfort and various operational speed regimes (in monoSTU the design speed depends first of all on the saging degree of a string-rail at the span and, consequently, on the span length).

a road bed with a sleeper grid and rubble prism (ground alternative) or a rigid load-bearing longitudinal beam or framework installed on the supports (elevated alternative) that are obligatory in the traditional modes of rail transport

2.2. Technological novelty of STU

The technological novelty of STU implies the use of light rail cars not requiring the complicated shock absorbers or amortization devices and considerable stabilizing masses to damp the shocks resulting from the uneven track which is typical for the traditional rail transport. Light STU unibuses are equipped with a derailment system to make them stable on the string-rail track even at travel speeds considered super-high for ground transport. The string-rail span structures of STU being a variety of hanging or guy bridges in terms of their rigidity, evenness, strength, reliability and durability meet the standard requirements imposed in Russia, USA and EU countries on the elevated mono-rail roads, high-speed railways and trains on a magnet suspension.

2.3. Organizational novelty of STU

The organizational novelty of STU is associated with the elimination of the need to use a traditional echelon-based scheme to organize the circulation of rail transportation modules according to the strict schedule. Low energy consumption of the light unibuses enables their operation as the self-propelled cars. In this case the total carrying capacity of STU routes is preserved or even increased as compared with the traditional modes of transportation using the long trains and powerful locomotives carrying hundreds of passengers at one go, however, due to their massive dimensions they are unable to ensure frequent circulation. The use of modern traffic control systems makes it possible to eliminate manual operation of unibuses and to fully transfer to the operation based on “a horizontal lift” principle with the origin-destination regime controlled by passengers themselves. As to the travel speed regime it is controlled automatically by a central STU post provided that all established running parameters and safety requirements were observed.

3. Key advantages of STU

The key advantages of STU over the traditional modes of transportation are the result of its novelty including the applied technologies and engineering solutions which is manifested in the following areas. The importance of these advantages makes it possible to refer STU to the breakthrough transportation technologies.

3.1. Reduced material-consumption in the course of construction

Availability of a super-smooth string-rail track enabling the high travel speeds eliminates the need in the use of complicated shock absorbers or amortization devices and artificial increase in the weight of unibuses to achieve the required stability as is the case in railways.

The use of an original string-rail STU track structure eliminates the need in the construction of material-intensive and high-cost earth embankments, road beds, bridges, elevated roads or longitudinal load-bearing beams with the relevant supports.

Elimination of the echelon-based circulation of unibuses provides additional opportunities for lightening the total weight of a string-rail track with the required evenness and rigidity of a track being retained. Elimination of the need to accumulate passengers for boarding the trains contributes to the considerable reduction in the platform length and the floor area of stations with the total carrying capacity and the high level of transportation services provided by the transportation system being preserved.

3.2. Increased durability of a track structure and unibuses

Cardinal reduction of shock impacts on the super-smooth joint-free string-rail track and 5—10-fold reduction in the contact voltage in the “wheel — rail” pair as a result of the improved standards of the steel wheel-rail interaction as compared with traditional railways makes it possible to considerably increase the service life of a string-rail and undercarriage component of the rail cars as compared with the railway rolling stock.

Elimination of a complicated suspension results in the simplified design of unibuses, reduced mass (including non-spring-loaded mass) and increased service life.

Automatic control enables the operation of unibuses within the recommended loads and in the absence of collisions and other accidents considerably increases their service life.

3.3. Reduced energy-consumption in the course of operation

Super-smooth string-rail STU track with the improved characteristics of the steel wheel-rail interactions contributes to the considerable reduction of energy consumption to overcome the rolling friction of wheels, namely: by 5—10 times and 10—20 times as compared with a rubber car wheel at low and high travel speeds, respectively; by 1.5—2 times as compared with a conical railway wheel.

Acceleration of the light unibuses characterized by the unique aerodynamic characteristics[3] to the high cruising speeds with their further maintenance requires considerably lower-power engines (by 3—4 times) and, accordingly, lower energy costs per 1 unit of the transportation service. In principle, such indices are hardly achievable in automobile transportation no matter how well it is equipped with the complicated and high-cost energy recuperators, hydrogen engines or fuel elements.

Elimination of the echelon-based strictly scheduled circulation of unibuses contributes to their improved operational efficiency and reduced share of idle running to result in the considerable reduction in energy costs per 1 unit of the transportation service.

4. Investment advantages of STU

The key advantages of STU resulting from the key design and technological innovations provide the basis for the identification of its investment advantages that, in its turn, are the subject of discussion in the course of the decision-making to promote the application of STU as the basic modern transportation technology to address the major transportation problems.

4.1. Consumer qualities

High accessibility of the transportation services (no barriers for laying the STU routes), all-weather operation and high resistance to the extreme nature conditions, minimal waiting time (unibuses are coming at call rather than according to schedule), high level of comfort in the course of traveling

[3] Aerodynamic resistance coefficient of a high-speed unibus experimentally optimized as a result of numerous wind tunnel tests was reduced to 0.007—0.08 which, for example, is 4—5 times better that aerodynamic qualities of a “Porsche” sports car

along the super-smooth string-rail track with higher speeds eliminating unnecessary stops and, finally, low net cost of travel are the qualities that help STU conquer a large share in the market of transportation services. This market of transportation services “of the second level” could supplement the existing market of the first level similar, for example, to mobile communications that managed rather to create an additional market than to replace the existing market of wire telephone connections.

4.2. Investment cost

Highly reduced material consumption of a string-rail track structure and unibuses, their simplified design and reduced floor area of STU stations with the preserved carrying capacity of the transportation system considerably reduce the investment costs entailed in the STU routes construction as compared with the traditional transportation systems.

4.3. Operational costs

The low level of energy consumption by unibuses, considerably lower maintenance costs of a track structure, especially in winter time, and reduced requirements in the service staff to operate a fully automatic transportation system having the longer service life make it possible to considerably reduce the net cost of STU transportation services as compared with the traditional modes of transportation. It, in its turn, considerably reduces the period of cost recovery of the transportation projects based on the use of STU technologies.

4.4. Environmental impact

Elimination of the need to occupy the wide strips of land for the distribution of a track structure and to carry out the large-scale earth works, a possibility to eliminate the demolition of structures to lay the STU routes within the urban built-up environment, rugged terrain and forests; low energy consumption, minimal noise and other environmental impacts create the necessary conditions enabling considerable reduction in the ecological costs and the integration of STU systems into any transportation project based on the use of STU technologies.