DESCRIPTION OF STU

String Transport of Unitsky is the newest transport system of the “second level”[1] characterized by the world novelty and international patent protection; it consists of an original string-rail track structure, infrastructure (stations, terminals, depots, etc.) and a special rolling stock –self-propelled rail automobiles (unibuses).

Land allocation requirements for STU are by hundreds of times lower than for highways or railways. STU with the spans between the supports ranging from 30 m to 2 km is capable to pass across marshlands, sands, water barriers, mountains, taiga, tundra and permafrost. Application of STU is efficient in all natural-climatic zones of the Earth (from -60°C to +60°C) to handle passenger and freight traffic in cities, between cities, countries and continents in any country of the world at the travel speeds ranging from 50 km/hour to 500 km/hour. STU is resistant to the atmospheric phenomena, earthquakes, floods and mudslides.

STU systems has been fully tested to cope with the Russian SNiPs (Construction Norms and Rules) and GOSTs and protected by the Russian and international patents. The key system nodes and aggregates are certified in compliance with the Russian legislation. In 2001-2008 the relevant building technologies including the track structure and supports as well as the main STU nodes and components of a freight STU were successfully investigated at the testing ground built in the town of Ozyory in Moscow Region (see fig. 1)

Key characteristics of the testing ground:

- Length of the route – 150 m;
- Summary tension of strings in the track structure – 450 ts (at +20ºC);
- Height of the supports – up to 15 m;
- Maximal span – 48 m;
- Maximal mass of a moving load – 15 t;
- Relative rigidity of the largest span on load – 1/1500;
- Metal consumption of a string-rail track structure – 120 kg/m;
- Track slope – 10%.

Fig. 1. **The testing ground of STU**

The aforementioned advantages make it possible within the short time limits to build a principally new type of transportation infrastructure enabling to solve the problems of intra-city, suburban and inter-city traffic while operating as the main and additional system to release excessive passenger and freight flows.

The current global financial crisis has an important role to play in the implementation of this project and provision of access to the Russian and international markets. All currently existing modes of transportation are associated

[1] Transport of the “second level” is designed as a track structure elevated above the ground and installed on the supports.

with the extremely high costs in terms of investments to their construction, maintenance and servicing. At the present time there is an urgent need in the development of a principally new transport system based on the advanced technologies and new standards capable to bring about radical changes in the ways of transportation of people and freights.

String technologies are associated with the low costs including human and financial resources both at the stage of construction and operation. Energy consumption by STU is 5-15 times less than that by automobiles and aircrafts, high-speed railways and trains on a magnet suspension. STU could become the most demanded product on the market of transportation services surpassing all world analogues in terms of its demand and characteristics.

SCIENTIFIC, PRODUCTION AND TECHNOLOGICAL RESERVE for the proposed Project implementation and previous outcomes achieved by the working team.

STU Awards:

- Diploma of a nominee for the National Public Award of the transportation branch of Russia - "Golden Chariot", March 2009;
- 2 Gold Medals of VVC: 2002 and 1998;
- Diploma of the International Transport Symposium in Libya, 2003;
- Diploma of the International Exhibition "Transport for cities, resorts and recreation zones" for the development of advanced environmentally-safe transport vehicles, components and equipment, 2002;
- Diploma of the International specialized exhibition of industrial transport and transportation services "PromTrans", 2002;
- Diploma of the International exhibition: "Industry and Transport: Cooperation and Collaboration", 2001;
- Diploma of the International exhibition: "Spectransport", 2001;
- Certificate of a Laureate of the national competition: "Russian Mark" – rewarding "String Transport Technologies" with a golden quality mark - "Russian Mark". Decision of the Higher Council of the "Russian Mark" No. 14 of October 16, 2001, Moscow;
- Certificate of a Laureate of the national competition "Russian Mark" – rewarding the "Project of a Passenger Module" with a golden quality mark - "Russian Mark". Decision of the Higher Council of the "Russian Mark" No. 14 of October 16, 2001, Moscow;
- Certificate of a Laureate of the national competition "Russian Mark" – rewarding the "Project of a Freight Module" with a golden quality mark - "Russian Mark". Decision of the Higher Council of the "Russian Mark" No. 14 of October 16, 2001, Moscow;
- Diploma of the International specialized fair-exhibition "MOBECO" for the presentation of the project of the high-speed String Transport of Unitsky, 2000;

- Diploma of the 1st degree of the International fair-exhibition “Innovations-98” to the winner in the competition of scientific-technological developments for the String Transport of Unitsky. October 20-23, 1998 (Moscow, All-Russia Exhibition Centre).

Support provided by the UN:

- UN Grant for the project No. FS-RUS-02-S03: “Provision of sustainable development of human settlements and environment protection through the use of a String Transport System” (USD 180,000, years 2002-2004);
- UN Grant for the project No. FS-RUS-98-S01: “Sustainable development of human settlements and improvement of their communication infrastructure through the use of a String Transport System” (USD 250,000, years 1998-2000).

Support provided by public foundations:

Soviet Peace Foundation:

- Grant for the development of string technologies to be used for ground and cosmic (alternative to a rocket) transportation systems (USD 220,000, year 1988);

USSR Federation of Cosmonautics:

- Grant for the development of a concept of a Planetary Transport Vehicle (non-rocket transport system to enter into cosmos that is based on the string technologies), USD 60,000, year 1988.

1. TRANSPORTATION SYSTEMS OF STU

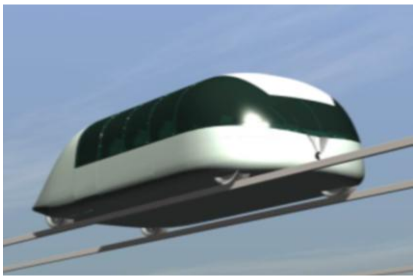
STU is represented by the following two principally different transportation systems.

1.1. Double-rail STU

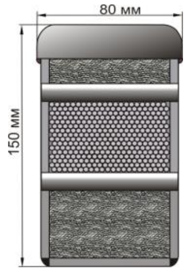
Its track structure is designed as two string-rail stretched with the total strength of 100—600 tons between the anchor supports installed with the intervals between them ranging from 1 to 3 km and based on the intermediate supporting masts having the spans of 20—50 m and more. Cross-sectional dimensions 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.

Double-track
double-rail STU in a city



High-speed unibus



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

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.

1.2. MonoSTU (single-rail STU)

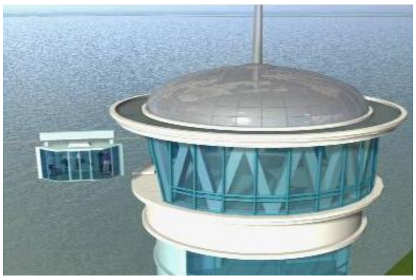
Its track structure is designed as one string-rail stretched with the strength of 50—200 tons between the anchor supports (specially designed buildings could serve as anchor supports) without or with the intermediate supports. Supports could be installed with the intervals of 100—3,000 m from each other[2]. 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.

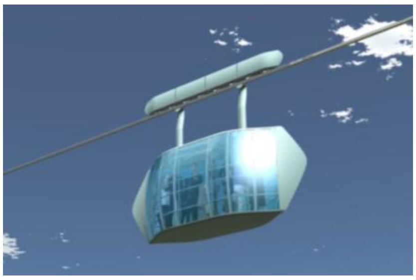
The rolling stock consists of single self-propelled rail cars[3] (mono-unibuses) hanged on the steel wheels under the string-rail and moving with the speeds ranging from 50 to 150 km/hour.

[2] 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.

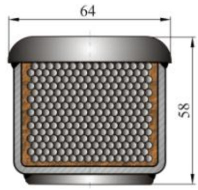
[3] Self-propelled rail cars — STU unibuses and mono-unibuses — could serve as passenger, freight or universal dual-mode (passenger/freight) vehicles of various carrying capacity and comfort and various operational speed regimes (in monoSTU the design speed depends first of all on the saging degree of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



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 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[4] 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] 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