IDEA

of

REVOLUTION

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President
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I am willing to bet that every day you and I share a common problem. 'Common' in that many other people have it; and that is very ordinary. This problem is transport. Existing means of transport are far from perfect and together with their advantages, have essential disadvantages. When driving to work, you are likely to be caught in a traffic jam; setting off on a long journey you have to stick to a train or plane timetable; exhaust gases poison us every day; diminish the ozone layer and make an irreversible impact on our environment and on the climate of our planet. Enormous sums are spent in order to build and maintain modern roads and lines, and directly or indirectly, they affect our pockets. I can go on listing the problems concerning modern means of transport and making you depressed, but it won't bring you any nearer to resolving the problem. Only a basically new design will help us today and be of great use for us tomorrow. This 'new' design is NTL. The idea of NTL (new traffic lines) takes in the advantages of existing means of transport but not their disadvantages. Is it a fantasy?

No, a thought revolution...

General constructor
Anatoli E. Iounitski

At the moment the EU is examining a series of draft designs concerning 'traffic corridors'. However, modern high-speed roads (and Mag Lev Railways) are extremely expensive and ecologically unsafe. They cost $ 10.000.000 and higher per kilometre.
The company NTL can propose a basically new means of high-speed transport which is inexpensive and ecologically safe.
The basically new idea of an ideally even (velvety) line will allow speed-limits of up to 500-600 kph. The relatively low amounts of materials necessary to build the line will halve the cost as compared to the cost of a traditional railway of the same length.
No harmful effluents will contaminate the air and soil because NTL works on electric power... No digging prevents the disruption of existing biogenesis in such fragile ecosystems as tundra, marshy and permafrost areas... Underground and surface water migration remain unaffected...

The construction I'd like to draw your attention to is known from mechanics. It is very simple but unique in its own way. The construction works in tension and is loaded up to the ultimate strength of material and can carry the same additional load without failing. It is a cable passed over two blocks and weighted at the ends (Fig.1). In the construction the strength properties of the cable are maximum because regardless of the external load P, the cable can work all the time at its ultimate strength without failing (increased load will lift the weights, leaving the stressed state of of the cable unchanged).
It should be mentioned that tension is the most favourable form of stressed-strain state for any stretched construction, e.g. a 100-metre cable the diameter of a finger can lift a 10-ton weight. To bear the same weight, a 100-metre span bridge which works by bending must have a load-carrying beam of some metres in height.
The cable construction can be easily transformed into a multispan system with one fixed end (Fig.2) and then one with two fixed (anchored) ends (Fig.3). According to calculations, if the load P is more than 100 times lower than the tensioning force T of the cable when other conditions are equal and cable stresses in Fig.3 will be less than 1 per cent higher than similar cable stresses in Fig.1 or Fig.2. This difference may be neglected, so these construction are supposed to be identical.
The principal diagram of NTL cable system is shown in Fig.3.
The cable sag when exposed to its own weight (the load distributed along its length) is shown in Fig.4;and when exposed to a concentrated load P applied to the centre of the span is shown in Fig.5.
When exposed to its own weight the cable sag of 10 -15 sm will take place under the following conditions: 200-500 tons and higher tensioning forces, 25-50 metre span, and the weight of the construction equals 50-150 kg per unit length (see the graphs in Fig.4). These can be easily "hidden" ("packed") into a special rail of 15-30 cm height (Fig.6,7).
The NTL line consists of with a cable rail line, support buttresses (every 25-100m), emergency buttresses (every 100-1000m) and anchor buttresses (every 1-10 km).
The NTL building method is simple,mechanized and automated. It has five stages:

(1) installation of anchor supports;
(2) cable-laying along the ground by the track;
(3) cable tensioning and anchorage;
(4) installation of intermediate supports;
(5) installation of rail sections and line structure with the help of a cable-driven platform;

I have already mentioned that when subject to pay load, the NTL car, stresses in the most loaded section of the cable road design will increase by less than 1 per cent so that this stress impact is negligable. Let's compare it to a construction which works by bending, e.g. a railway bridge span. The latter is subjected to tension and compression cyclic stresses which differ from each other by tens and even hundreds per cent; minimum stress is off-load; maximum stress when a train is on the bridge span. It results in a necessity for a safety margin, fatigue phenomena and reduces its service life.
The effect of temperature stresses on the stressed state of the cable line design must be taken into account. A cable should have no movement (functional) joints along its length. If the weather changes, the cable's service properties are similar to the service properties of a telephone wire or power transmission line service properties hanging from supports and stretching for many kilometres with no joints. Let's take a 25-metre span. Then temperature changes from -50°C (in winter) up to +50°C (in summer) will cause following changes in metal string sag: in summer it will increase by approx. 2.5 mm. (1/10000 of the span length); in winter ,on the contrary, it will reduce by 2.5 mm. At the same time, the stretching stress in a cable will increase by 500 kgf/cm² in winter and in summer will diminish by 500kgf/cm². If cables are stretched up to the stresses, e.g. of 8000 kgf/cm² on installation, their stressed states will change from 7500kgf/cm² in summer up to 8500kgf/cm² in winter while the NTL is in use.
High speed steel, glass fibre, carbonic plastic and other highly durable materials are suitable for cable production.
Since the rail head is placed on the construction which stretches up to a few hundred tons, the compressive forces in its separate elements should exceed the magnitude given due to temperature differences so that the construction can lose its transverse stability. The maximum compressive force in a rail head is 10-15 tons, in a rail body- 2-5 tons, and in a filler- 3-5 tons. So, the maximum sum of the compressive effort in the rail elements will be 15-25 tons, i.e. less than 10 per cent of a cable's tensile

Fig. 1

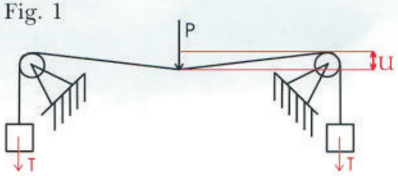


Fig. 2

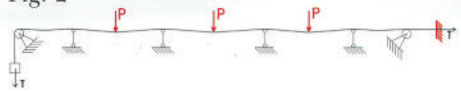


Fig. 3

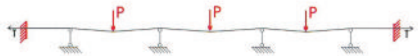
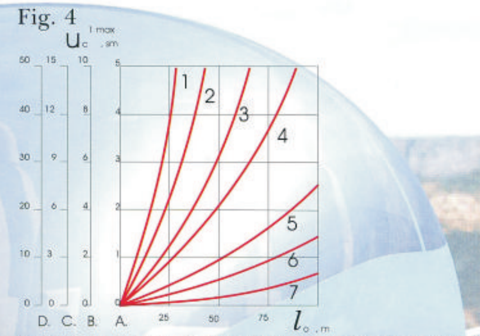
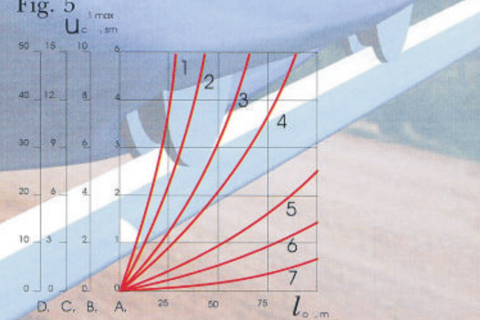


Fig. 4



Maximum cable sag parabolas when exposed to the weight of the line structure : a- when p1=50 kg/m; b- when p2=100 kg/m;c- when p3=150 kg/m; d- when p4=500 kg/m; 1-7 when T=100,250,500,1000,2500,5000,10000 C°

Fig. 5



Maximum sag of the line structure when exposed to a unit load: a- when P=1 TC;b- when =2 TC;c- when =3 TC;d- when =10 TC; 1-7 when T=100,250,500,100,2500,5000,10000 TC

Fig. 6

force. That is why, even being exposed to the above-mentioned compressive force, the rail will not lose its stability. The compressive force can become zero if the rail head and body are prestretched on installation. If any rigid material is used as a filler, e.g. concrete, rolling movement joints must be installed every 5-25 m.

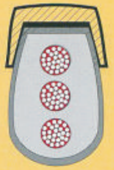


Fig. 7

One method for rail construction

A rail is supposed to have three strings, each made of steel wires with a diameter of 1-5 mm and stretched to a force of 50 tons. The rail head must be made of steel in the form of a channel and fastened to the body. The body must be made of sheet aluminium in order to reduce the electrical resistance of the rail and to maximise transmitted electric power. What is more, aluminium is resistant to corrosion, so the rail does not need painting. The body is filled with composite polymer material and filler. A rail weights 20-50 kg per unit length and it costs 40-60 USD per unit length in Belarus when full-scale production is achieved.

During NTL installation, anchor supports are subject to unilateral forces of 200-500 tons (along the road). This effort will be balanced from the opposite side when the road is ready. Support buttresses take in a central load of around 10 tons, taking into consideration the dynamics of motion. That is why the support buttresses at the most expensive part of the supporting part of NTL can be open-work that is not so expensive. High supports and supports in areas with strong winds should be constructed as stable trusses in order to guarantee cross stability and prevent any line bending which might be caused by side wind.

Motion dynamics were investigated theoretically for the 100-800kph speed range. The rates of car motion and traffic flow were determined as well as the characteristic properties of a rail. Taken together they give the dynamic deflection of a rail within 10 mm (with a 25-50 m span and car weight of 2000-3000 kg). Under certain motion conditions, a car can slide along smoothly because the vibrations behind the car (vibration amplitude <=10 mm), die out in 0.1-1 sec, so the next car may move on ideally and evenly.

The NTL car should be equipped with 3-6 seats for passengers (just as in a motorcar) or 7-15 seats (like in a minibus). The carrying capacity of the traffic unit should be 1-2 tons (freight version). Since the road can be built ideally even and the road structure itself is a very stable system when exposed to a mobile load, so the car can achieved the speed of 300-500kph. Having investigated different modifications for the car frame, we worked out the optimal one, with an aerodynamic drag coefficient of Cx=0.075. It should be pointed out that at the moment there are no means of transport possessing such high aerodynamic properties. These figures are the result tests on an NTL model unit (scale 1:5) in a wind tunnel (at 250 kph). An engine of 100 kw power will guarantee a speed of 350 kph. The following three types of car drive unit are most reasonable :

- electric wheel drive (direct or reduction gear);
- motor-wheel and
- shaft-fixed (fastened) pusher propeller;

The engine will receive electric power through the wheels.

NTL lines can guarantee a very high carrying capacity, e.g. the average distance between adjacent cars will be 1400 metres if the speed is 300 kph, a seating capacity of 10 people and a passenger flow of 100 000 people every 24 hrs. This interval can be reduced to 100 metres and the carrying capacity doubles.

The cost of the NTL Line is between half a million and a million USD.

While calculating, we took into account the cost of the following constructions:

- steel constructions are approx. 1000-3000 USD per kilometre;
- aluminium constructions are approx. 4000-5000 USD per ton;
- reinforced concrete constructions are approx. 200-500 USD per m^3;

Therefore, the average passenger price for a 1000 km trip is 10-15 USD with a passenger flow of 50 000 per day.