Air Suspended and LIM Propulsion Transport System for goods: TALPINO introduced by WALUSO e.V.

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Abstract

TALPINO is a transport system based on air cushion suspension driven by linear induction motors (LIMs). The suspension allows the vehicle to glide on air over the track surface. Double-sided LIMs are mounted on the vehicle and drive into a reaction plate fixed to the ground. The system allows sophisticated logistic solutions for loading and unloading different goods in a short time. The speed of TALPINO is about 80 to 120 km/h, with a vehicle headway as low as 10 seconds. This provides a transport volume greater than anything in use today. System capacity is very high and at a lower cost than rival solutions. We are convinced that TALPINO tracks are the ideal solution wherever there is a transport volume with over 50 million tonnes per year in both directions.

1 TALPINO, the solution for goods transport

1.1 **Overview**

by M. Prachensky

Talpino is the traffic solution for large and greatest transportation of goods.

In Europe there are potential routes crossing the Alps, or connections between ports and industrial and consumer zones.

But also here in China TALPINO seems to us to be a good solution for solving freight traffic problems innovatively and, above all, very effectively.

We are not aware of any other system able to transport 50 to 250 tonnes of payload every 10 seconds, and in Europe this method is cheaper than by car or truck or by train. Costs are similar to those of ship transport on artificial waterways.

In Europe there is an opportunity for a few high-performance goods transport networks, e.g. Genoa-Milan, Munich - Prague – Warsaw - Moscow and Rotterdam - Ruhr district – Munich – Vienna – Budapest - Kiev.

Some examples:

TALPINO route across the Alps: Munich – Milan - Genoa

TALPINO turntable Vienna with connection to the region of the European Union Eastern Expansion (Budapest)

For Shanghai we present to you a first model of a TALPINO system “**TALPINO metro Shanghai**” - a combination of an intensive traffic compound system which leads to traffic calming.

TALPINO consists of some patented components, we want to introduce now:

1.2 The track(way)

By F. Ducia

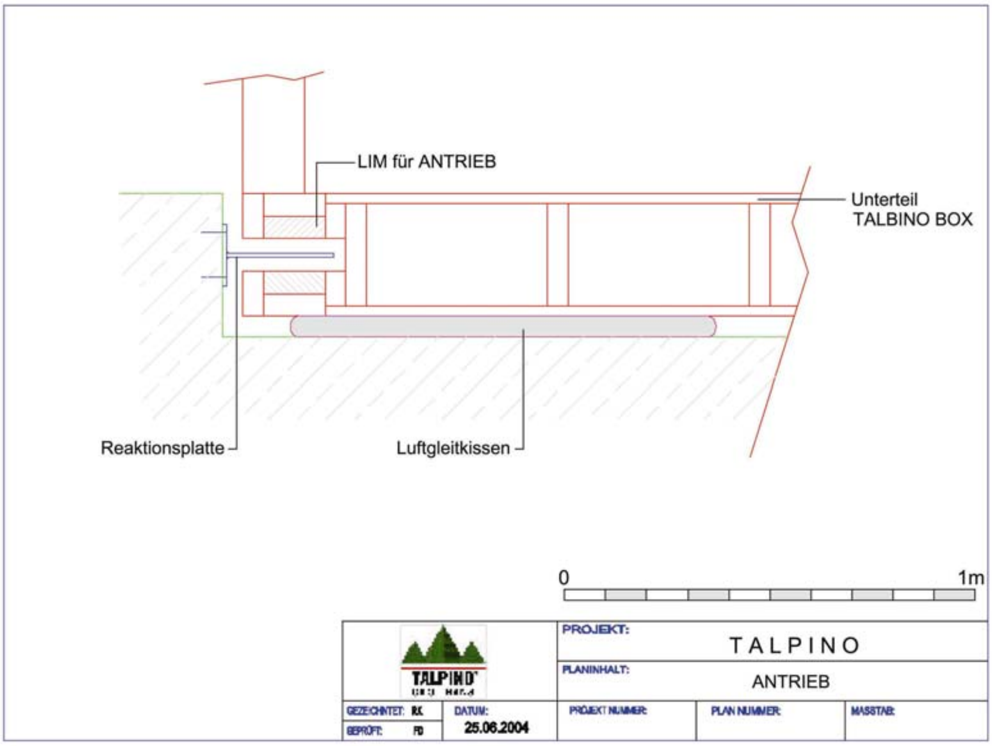
We will use new concrete tracks. These tracks are plain and coated to allow the air cushion to glide over them. There is a maximum height in the middle of the track, whilst the flanks are lowered some centimeters. We will use the same gauge as railways. There are no switches in the track, the box or vehicle - as you will hear later - finds its own way straight on, to the right or to the left. For safety reasons the TALPINO vehicle is always enclosed and travels in a compartment or tunnel. In the alpine mountain region this will be a real tunnel (similar to that used by the railways at the St. Gotthard in Switzerland). In a “hilly” landscape we will cut tunnels into the ground. This is very advantageous because we can drive uphill and downhill with grades up to 10%. In flat areas we will consider a housing in tubular form, built with light steel foam glass concrete construction and on which we have enough space to fit solar collectors, if they are suitable for industrial use.

Our track is a U-tube in concrete and on the sides we have the aluminium reaction plate for the LIMs.

1.3 The LIM

By Alan Foster

LIMs are in regular use today throughout the world as drives for many industrial applications and transport of people or goods. In particular they are used extensively for airport baggage handling and parcel sorting systems because of their effectiveness and reliability. In the near future it is expected they will also be used for urban people movers (PRT), for aircraft & missile launchers, and more extensive good transport.



LIMs are very robust and there are no moving parts to service or replace. They do not require accurate installation or alignment and realistic construction tolerances can be used. They work indoors or outdoors, and sealed LIMs can even work under water if necessary. LIMs are energy efficient because they are only energised when needed and output power is controlled to match the exact load requirements.

LIMs are presently manufactured in many configurations up to approx. 2m long with power outputs up to 100kW. Double-sided operation has the advantage of eliminating normal forces on the reaction plate and providing easier mechanical alignment. In this case the reaction plate (equivalent to the ‘rotor’ of a conventional induction motor) is a simple aluminium extrusion. This is cheap to make, easy to install, and very reliable. Heat induced in this aluminium by the LIM will be easily lost to the atmosphere.

Control systems have become more practicable and sophisticated due to reduced costs of inverters. However, many ‘standard’ inverter drives are not suitable for use with LIMs but a few are configurable using special control algorithms for optimum closed loop speed control.

Non-contact braking is readily achieved by either reversing the direction of motor’s travelling field to oppose motion (plug braking) or by reducing the drive frequency so that the motor’s synchronous speed is less than the vehicle (super-synchronous braking). For optimum power control both methods are used under different operating conditions.

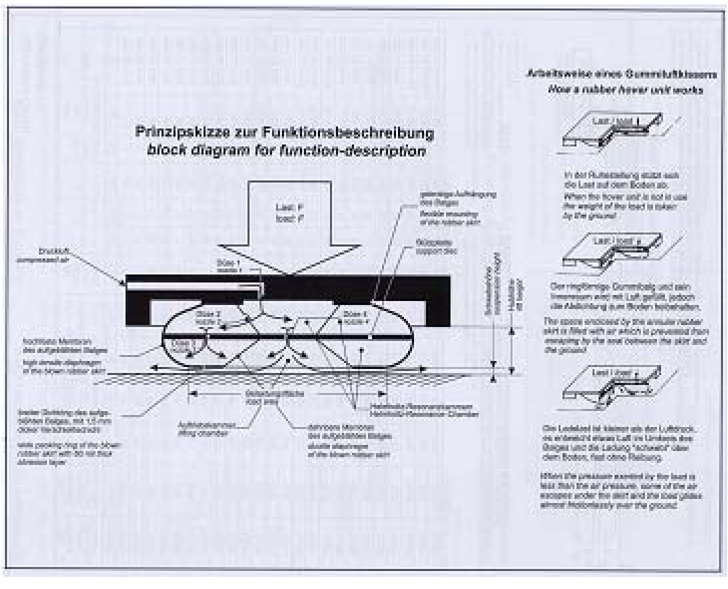
The LIM winding, reaction plate, airgap, and control all form part of an integrated solution. Any significant application demands a thorough design optimisation review. This will be carried out for Talpino.

There is a real commercial interest to use LIM drives for containers and pallets for transport of goods both over- and under-ground. The result of the proposed Talpino study will be an appraisal of the engineering challenges for high speed surface transport, energy requirements, installation and running costs, together with manufacturing and construction issues.

1.4 The air cushion

By H. Michels

For 25 years the air cushion system has been used for the transport of heavy and very heavy goods. Unfortunately until now it has mostly only been used indoors, and at low speed. But it is now possible to transport up to 1000 tonnes with no problems. TALPINO needs a slightly different type of air cushion: the pressure should not be higher than 1 bar, and the air consumption should be about 7,5 m³/min for a TALPINO box of 50 tonnes. We can automatically measure the weight of the TALPINO box. This information will then be used to control the LIM power and determine the necessary length of acceleration track.



The surface of the track requires the most attention: it is easy to produce (i.e. cheap, fast and easy to adapt and repair in case of failure). We know that we can use polyethylene condensate, but we are still looking for a method of coating it easily on a concrete surface. A German company is using a thin glass-film, but until now this way is too expensive for a track of some hundreds of km.

The air cushion must be stable in any occasion. There is the danger of "overturning", therefore we use a patented inner steel-ring, to ensure the rubber adheres to the track. We have two independent systems of inflating air, which allows us, in case of failure, to ride with one system until the next service point. We also have the possibility to react to uneven loading. Under the heavy part of the box the air cushion is inflated more than at the less loaded parts. The construction and the regulation of this air cushions must be planned together with the static-dynamic construction of the box.

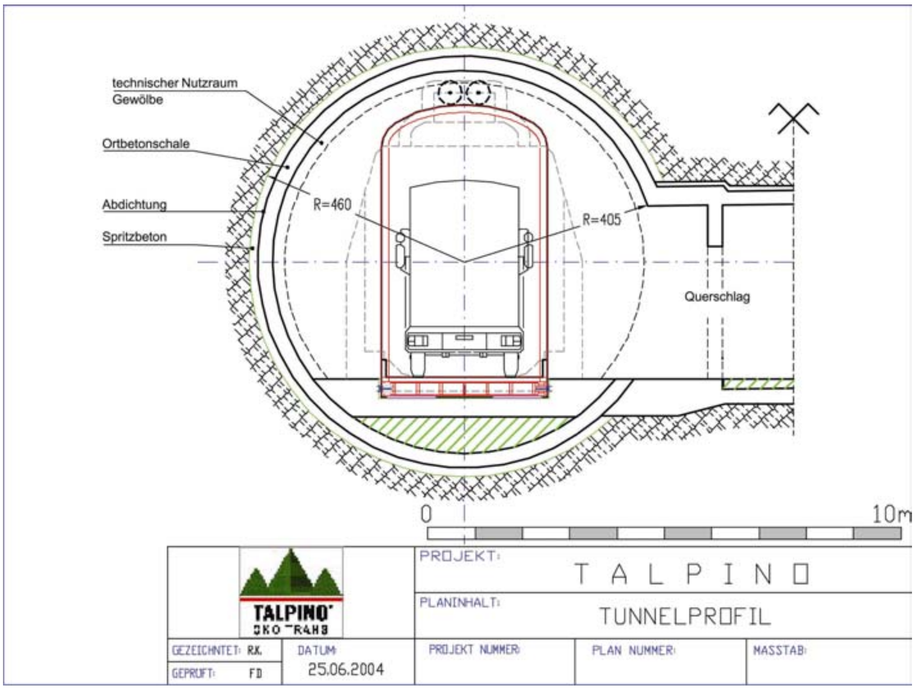
1.5 The box

By G. Wagner

The TALPINO concept together with the implementation of new technologies like LIM – drives and air cushion systems in the TALPINO cargo transport unit resulted in new and, compared to existing systems like trains and trucks, completely different demands to the supporting structure and the frame of the box unit of the TALPINO.

The currently most common solution for cargo wagons is the bogie based design principle leading to a "beam shaped" undercarriage unit with relatively massive sole bars due to the support in only two points by the bogies. The use of multiple air cushions to support the TALPINO cargo system offers a new scope in design at the first glance. But taking into consideration that TALPINO should not only be used for container transport but as a carrier vehicle for heavy trucks as well one could see that the TALPINO faces quite similar problems railway systems do. Furthermore not only the load distribution from the goods to the undercarriage unit and from the unit to the ground is a challenging engineering task but also the implementation of the LIM drive units within the TALPINO carrier platform.

Together with the FIFO logistics concept of the TALPINO that allows "inline" loading and unloading of the TALPINO vehicles the new LIM drive concept and the air cushion system resulted in a new design principle of the box and undercarriage unit. But as already mentioned, the ongoing development of the LIM drive systems and the air cushion units will probably bring up new demands for the box design so there is a continuous and parallel improvement process in the design of the box in order to meet all the upcoming demands.



2 Acknowledgments

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