URBANTRACK

Urban Track

NEWSLETTER Nº 3 OCTOBER 2008

Low costs modular new track systems & fast installation methods

Installation test of REMS in the Metro de Madrid network

The development of the **R**emovable **E**mbedded **M**etro **S**ystem has reached another milestone. A 54 m long track section of the new rail system was recently installed in the Metro de Madrid network.

REMS is an extension of the CDM Prefarails technology. It uses special rubber jackets and a key based locking concept, to allow the easy rail replacement of an embedded rail system. This Urbantrack development aims the application of embedded resiliently supported rails in metro tunnel, where a fast evacuation in case of emergency over a flat track surface has become a major concern for metro operators.

REMS is another example in accordance with the Urbantrack objective to functionally develop track systems while keeping life cycle cost in mind. The easy and fast replacement of worn down embedded rail is the main technological challenge addressed by REMS.

The installation of 54 meter of test track in Madrid is the initial part of the validation process of REMS. Practical installation issues, speed of execution and rail replacement were tested, preparing the larger scale validation foreseen in the Metro de Madrid network during the second half of the Urbantrack project.

Figure 1 : Jacketing of rail, positioning of rails before concreting, finished REMS track.

Figure 2 : Unlocking of jacket, rail removal, rail re-insertion and track operation.

www.urbantrack.eu

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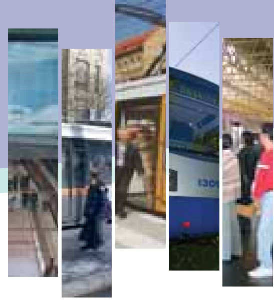
SIXTH FRAMEWORK PROGRAMME



Tests on a test circuit and hydro-pulse-facility for embedded tracks

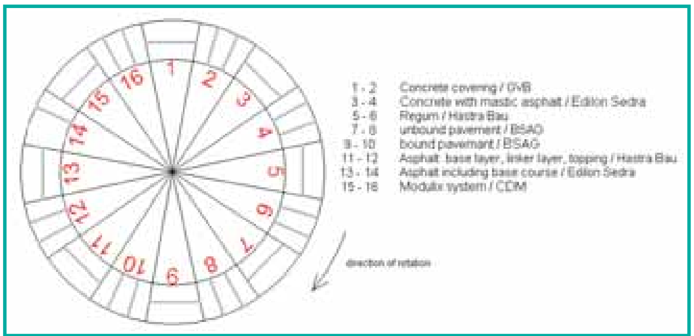


Figure 1: Overview of the arrangement of the 16 test bodies in the test circuit

Tracks embedded in roads are subject to stress both from tram vehicles themselves and from heavy goods traffic (buses and lorries), exerting stress on the tracks both crosswise and lengthwise. Since repairs can be very costly and may even sometimes require temporary road closures, solutions should be sought to prevent damage and, if this is not possible, ensure that it occurs only after a lengthy period of use.

At STUVA's facility, various tests were carried out simulating the load exerted on track surfaces by buses and lorries over a period of ten years. A total of 16 different track types were tested: eight with a firm carriageway surface and eight with a 'green' one capable of being driven over in an emergency (six with granulate for sedum and two with artificial turf on top of concrete bodies).

Figure 2: Displacements on test bodies 7 and 8 at 30°C during the first cycle

Regarding the tests' results of the eight firm carriageway surfaces (two variants of asphalt, three of pavement and three of concrete), with the exception of the pavement structure comprising natural stones secured with an elastic joint-sealing compound (test bodies 7 and 8), all test bodies withstood the load more or less well. All surfaces of the individual test bodies were 'deformed' in various ways by the wheel crossings. Most severely affected was the unbound pavement (test bodies 7 and 8), followed by the asphalt base courses (test bodies 11 and 12). By contrast, after the tests, the concrete bodies remained largely unaffected. In summary, the tests revealed that all test bodies with a concrete structure up to the surface, including a structure of natural pavement with a backfilling of concrete, withstood the tests well. This structure is to be recommended for heavy loads exerted by buses and lorries.

The green tracks studied, which should be capable of being driven over by emergency vehicles, yielded different results. These tests were performed with a lower axle load, at a slower speed and over shorter test duration. The solutions using artificial turf on a concrete solid body withstood the loads well without sustaining any significant damage. By contrast, all test bodies designed for planting with sedum failed when subjected to a load for only a short period. A renewed construction of these test bodies yielded considerably better results.

Economic Assessment - Life cycle cost (LCC) calculation

Figure 1: Screen shots of software tool LCC-UrbanTrack (www.urbantrack-sp4.eu)

After significant efforts for the development of the LCC model, Urban Track's SP 4 Team has finalised the specification of the software tool and the software tool itself, which is a web-based solution easily accessible to partners across Europe and the world. Initial ideas had been discussed in-depth with European operators and within the Urban Track consortium. A first LCC calculation workshop has been held in Frankfurt in June 2008 where the partners from Sub Projects 1 and 2, in particular, were taught how to feed their data into the software and how to calculate their LCC. First calculations have then being carried out, especially by Sub Project 1 in time for the last reporting period in August 2008. Obviously, this tool could also be of interest to other operators across Europe wanting to carry out some comparative LCC calculations using a relatively simple and accessible tool, free of charge. In this sense, the new software tool is a world first, as it provides the opportunity to carry out LCC calculations easily accessible from the web, including an assessment of the impacts of various changes, e.g. to maintenance regimes or infrastructure.

An additional tool's feature to come in a short time is the Knowledge-Base, where partners will be able to search all entered data for benchmark values regarding LCC-infrastructure-relevant topics.

Following the first LCC calculation workshops, dates for a second and third workshop have been identified at which users of the tool can familiarise themselves with both the LCC principles used in Urban Track and the tool itself:

- 10th /11th of February 2009, Frankfurt / Germany
- 06th /07th of October 2009, Frankfurt / Germany

Socio-economic costs and benefits

Another result of the last months is the finalisation of the methodology to assess the socio-economic costs and benefits of the different rail technologies. Based on discussions with partners, experts and European literature, we have defined the relevant impacts and their monetary values. For the building site we look at noise, vibrations and turnover compensation, for the detour we included costs of congestion, fuel, road accidents, noise, emissions, climate change and Public Transport compensation. Besides, the methodology also allows an assessment of the ecological impact of the used materials. It is possible to incorporate the results of the socio-economic assessment into individual cost elements within the LCC tool that has been developed in the other work packages of SP 4.

During the installation the main cost components are the turnover compensation, the Public Transport compensation and the costs for time (congestion) and fuel of other traffic on the detour imposed by the construction works. As the illustration shows, the amount of days the street has to be closed down for traffic has a substantial effect on the socio-economic costs for the three most important categories of costs. Reduction of time has a very positive effect on the socio-economic costs. Also the space which is needed to install the rail technology has effect on the socio-economic costs. The use of the track bedding for most of the works and only a few periods of closure means a remarkable reduction of costs. The example shows the effect of 60% of the original traffic volume during works compared with no traffic at all during works. For maintenance and refurbishments the results are similar. During operation, the main cost reduction is caused by less noise or less vibrations.

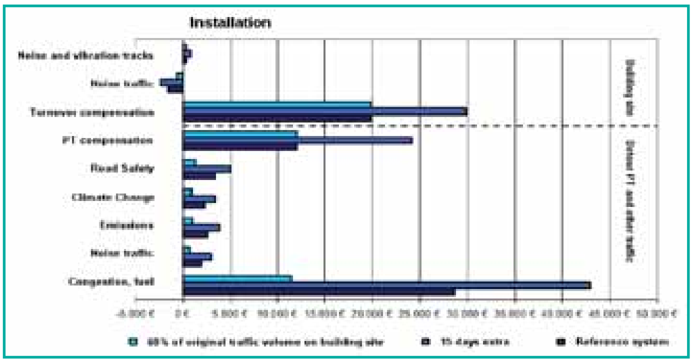


Figure 2: Comparison of socio economic impacts of different areas

In order to refine the methodology and to integrate some non-qualitative impacts, we will apply the methodology to cases of SP 3.

All ongoing work in the area of economic assessment is frequently presented to the network operators and other partners of the Urban Track project to invite comments and criticism furthering and improving their development. There is a specific website for all SP 4 work including links to LCC calculation tool and a helpdesk system also accessible to the interested public http://www.urbantrack-sp4.eu

Functional requirements

The WP5.1 & 5.2 are focusing on defining a generic model for the track and the vehicles. For this reason during the first year a questionnaire was sent out through UITP to different tramway and/or metro operators.

The feedback of this survey was analysed and a synthesis could be set up :

- For the vehicle characteristics :

- For the track characteristics :

UrbanTrack SP5 : Fonctional requirements — Draft

Track Characteristics

x : Don't exist
? : No information

Comments to Si Hai MAI and Frederic LE-CORRE

juin.08

No.	Network	Type	Line feature		Track geometry		Track components			Stiffness		Others
1	Bremen		Length of the reference line (km)		Minimum line curve radius (m)		Rail profile			Rail pad stiffness Static (kN/mm)		
			Number of stations/ stops		Maximum track cant (mm)		Rail hardness (Hb)					
			Distance between stations (average)		Maximum cant deficiency (mm)		Continuous welded rail (%)			Rail pad stiffness Dynamic (kN/mm)		
			% of length of curves 50m<R<100m		Maximum twist (mm/m)		Nominal fasteners spacing (mm)					
			% of length of curves R< 50m		Track gauge in tangent track (mm)		Other fasteners spacing (mm)			Resilient fastening stiffness Static (kN/mm)		
			Number of S&C		Gauge widening in curve (mm)		Rail support (%)	Wooden sleepers				
			% of track length in tunnel		Steepest slope (%)			Mono-bloc concrete sle		Resilient fastening stiffness Dynamic (kN/mm)		
			% of track length at grade		Rail inclination			Two-bloc concrete sleepers				
			% of track length on bridge and viaduct					DFF-Direct Fastening Fasteners		Under sleeper pads stiffness Static (kN/mm)		
			Exploitation time (number of year)					Other				
					Alignment (dressage) (mm)	?	Track bed (%)	Ballast		Under sleeper pads stiffness Dynamic (kN/mm)		
					Surface (nivellement) (mm)	?		Concrete panel				
								Floating slab				
								Other				
							Fastening type					
2	Brno	Tramway	Length of the reference line (km)	13.89	Minimum line curve radius (m)	25	Rail profile			Rail pad stiffness Static (kN/mm)	?	
			Number of stations/ stops	26	Maximum track cant (mm)	135	Rail hardness (Hb)		?			
			Distance between stations (average)	0.534	Maximum cant deficiency (mm)	3	Continuous welded rail (%)		100	Rail pad stiffness Dynamic (kN/mm)	?	
			% of length of curves 50m<R<100m	4.5	Maximum twist (mm/m)	2.5	Nominal fasteners spacing (mm)		?			
			% of length of curves R< 50m	2.5	Track gauge in tangent track (mm)	1435	Other fasteners spacing (mm)		x	Resilient fastening stiffness Static (kN/mm)	?	
			Number of S&C	?	Gauge widening in curve (mm)	20	Rail support (%)	Wooden sleepers	15			
			% of track length in tunnel	1.2	Steepest slope (%)	50		Mono-bloc concrete sle	70	Resilient fastening stiffness Dynamic (kN/mm)	?	
			% of track length at grade	93	Rail inclination	0.0		Two-bloc concrete sleepers	0			
			% of track length on bridge and viaduct	5.8		1:20		DFF-Direct Fastening Fasteners	0	Under sleeper pads stiffness Static (kN/mm)	40	
			Exploitation time (number of year)	?		x		Other (Concrete panel 386x220x20cm)	15			
					Alignment (dressage) (mm)	?	Track bed (%)	Ballast	75	Under sleeper pads stiffness Dynamic (kN/mm)	40	
					Surface (nivellement) (mm)	?		Concrete panel	25			
								Floating slab	0			
								Other	0			
							Fastening type					

In addition to the generic definition of track and vehicle, the degradation observed were examined.

The main track degradation that could be identified are :

- ✔ Rail Corrugation
- ✔ Rail wear
- ✔ RCF