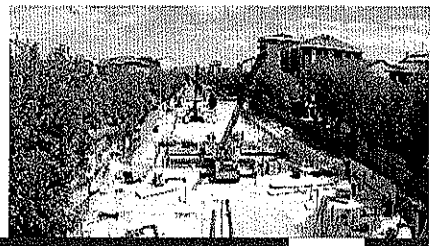

Turin Metro Line 1
MetroTorino
MetroTorino
the Metro moves the City



Turin Automatic Metro

Turin Automatic Metro is a reality: the impact of the building sites and the fast-evolving construction stages with their day-to-day repercussions on traffic flows leave no doubts as to the fact that works are really rolling.

The contractor companies are at work along the entire line, at 15 sites stretching over just under 10 kilometres, from the depot/workshop - that will shelter the Metro trains starting in 2004 - to the Porta Nuova station in the city centre.

The first stage consisted of moving tens of kilometres of underground utility lines, at a cost of ca 20 million Euro. This preliminary task proved extremely complex, since it involved coordinating the activities of 31 different utility companies. This stage has now been completed in corso Francia and will soon be over in corso Vittorio Emanuele II too.

In corso Francia, the construction of the stations is well underway: in some cases digging works have been completed, producing a box-like structure 60 m long, 19 m wide and 18 m deep. Digging under cover minimises noise and dust, and little can be seen from the surface.

The major event which is scheduled to take place over the new few months is the actual carving of the tunnels: the first TBM is already in operation at the Fermi site, and two more will be activated within few months. Once the TBM has passed, it will be possible to complete the civil works by casting the slabs at the mezzanine, hall and road access levels. The next stage envisages the finishing works for the stations, the installation of the technological systems and the safety apparatus; since most of these activities will be performed below road level, their impact on the city will be greatly reduced.

Indeed, we have had our "special moments": the unearthing of a bomb from WWII, the discovery of a Lombard necropolis in Collegno, an encounter with a elephant which had escaped a circus and was temporarily put up at the Racconigi site.

Obviously, at this stage, the sites create some disturbance, but when, at the end of 2005, it will be possible to appreciate all the advantages of the Metro, people will ask for further kilometres of underground tunnels, as they always do when a city is provided with a Metro.

*Many citizens have realised this as borne out by the fact that about 15% of the inquiries received at our e-mail site **www.metrotorino.it** are from people who want to know if and when additional lines are going to be built.*

Satti Spa, in liaison with the City of Turin, the other communes of the metropolitan area concerned, the Piedmont Region and the Ministry of Infrastructure, is working actively along these lines.

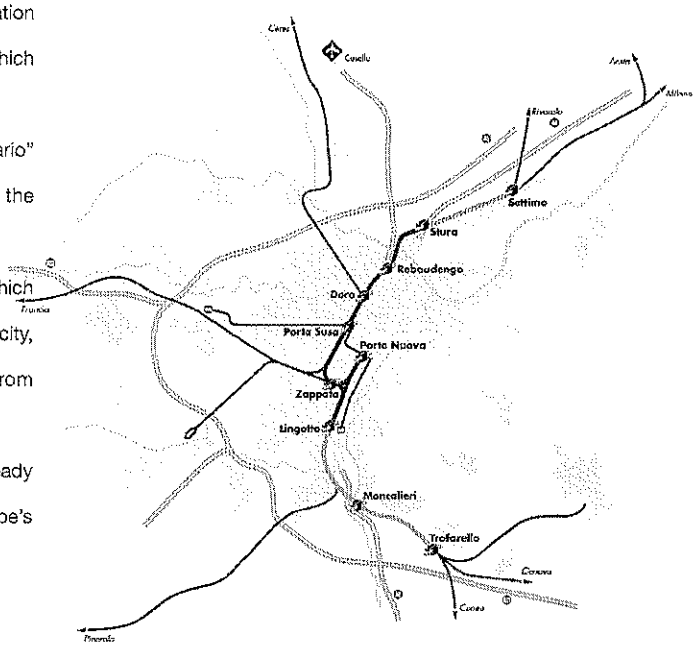
Satti Spa – Divisione Metropolitana (Metro Division)

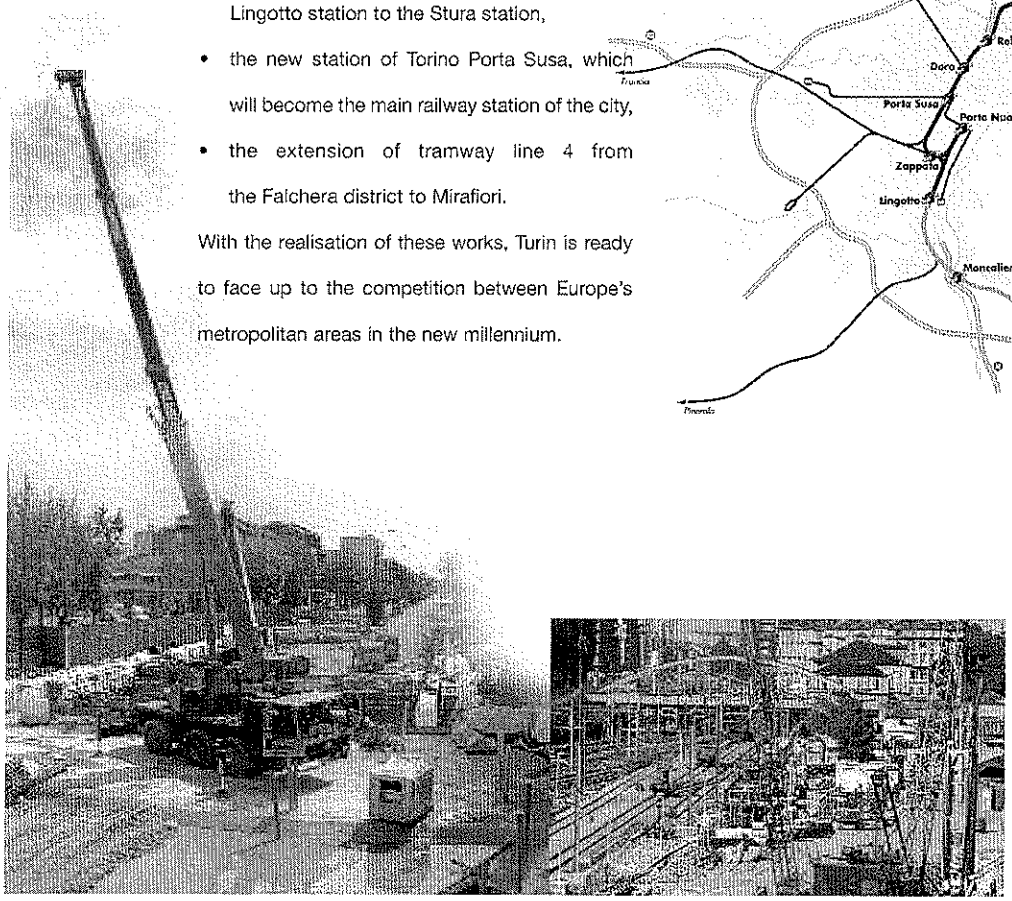
2 The Metro and the transport system

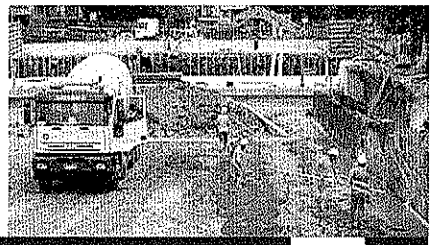
Line 1 of the Metro is part of the program for the improvement of the public ransportation system in the metropolitan area of Turin, which envisages:

- the completion of the "Passante Ferroviario" (underground railway junction) from the Lingotto station to the Stura station,
- the new station of Torino Porta Susa, which will become the main railway station of the city,
- the extension of tramway line 4 from the Falchera district to Mirafiori.

With the realisation of these works, Turin is ready to face up to the competition between Europe's metropolitan areas in the new millennium.





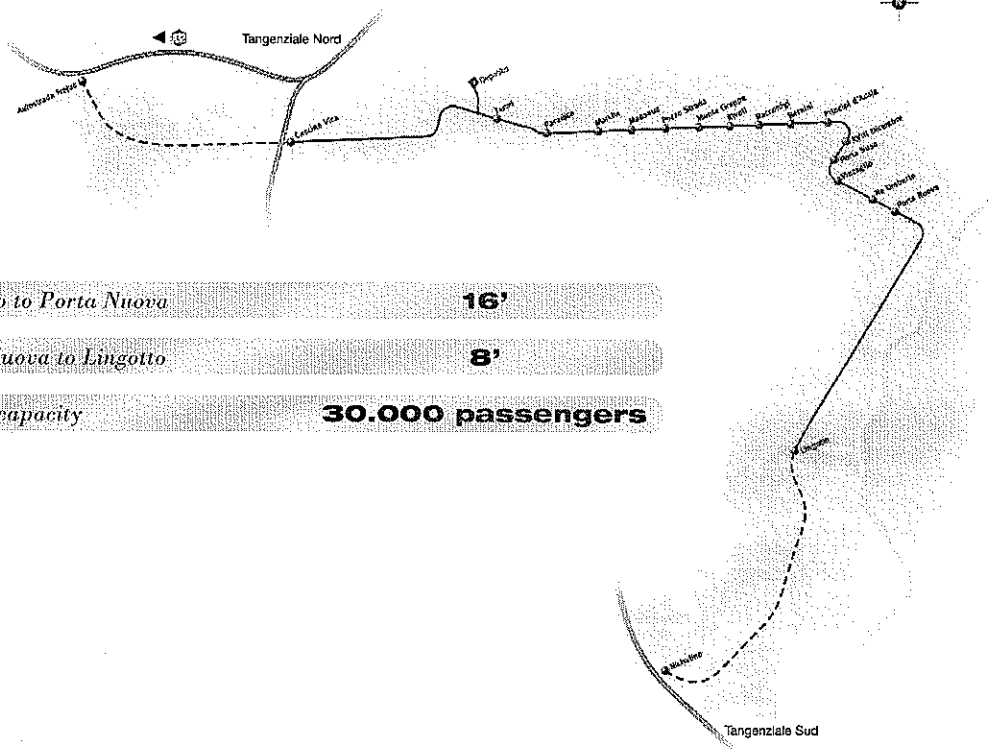


The route of Line 1

Line 1 of the Turin Metro will run along the Rivoli - Cascine Vica - Collegno - Porta Nuova - Lingotto - Nichelino route extending over ca 28 km.

Its construction is taking place by sections:

- the works for the section linking the commune of Collegno to the Porta Nuova station began in December 2000; this section, which is 9.6 km long and has 15 stations, will run under corso Francia, corso Bolzano and corso Vittorio Emanuele II;
- the sites for the Porta Nuova - Lingotto section, extending over ca 6.5 km, will be inaugurated in 2003. This will be followed by an extension to the commune of Nichelino;
- works for the extension from Collegno to Rivoli – Frejus motorway, approximately 12 km in length, will be started in 2005.



Collegno to Porta Nuova	**16'**
Porta Nuova to Lingotto	**8'**
Hourly capacity	**30.000 passengers**

4 VAL - A fully automated system

The Turin Metro uses the VAL (Light Automatic Vehicle) system. Designed and developed by Matra Transport (now Siemens), it is one of the most thoroughly tested automatic underground systems the world over, from the standpoint of safety, reliability, performance and costs; at present it can boast over 120 km of underground lines in operation in the cities of Lille, Paris, Toulouse, Rennes, Chicago and Taipei. The key feature of this system is total automation, ensuring high service levels and low running costs. VAL 208 type trains are 52 m long and 2.08 m wide; each consisting of two bi-directional vehicles which, in their turn, are made up of two units permanently coupled to one another.

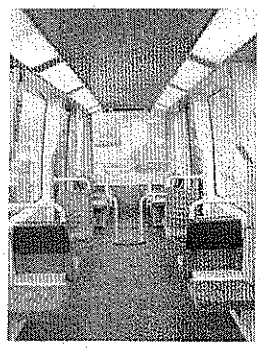
The use of small sized vehicles makes for shorter headways, while vibration and noise are minimised thanks to light alloy bodies and tyres rolling on steel tracks.

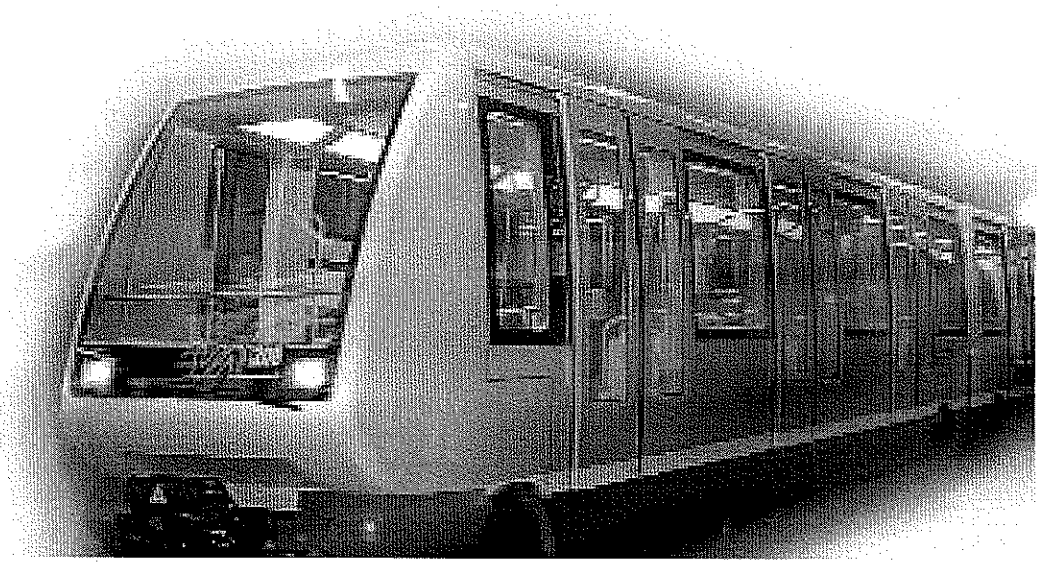
Max. passenger capacity per train: 440 people

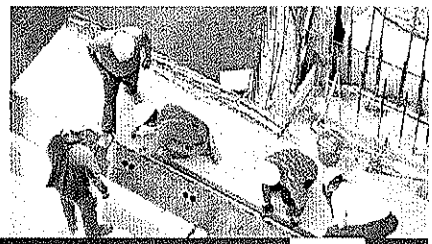
Max. speed: 80 km/h

Average service speed: 32 km/h

Headway: 4/6 minutes normal hours, 2 minutes rush hours.





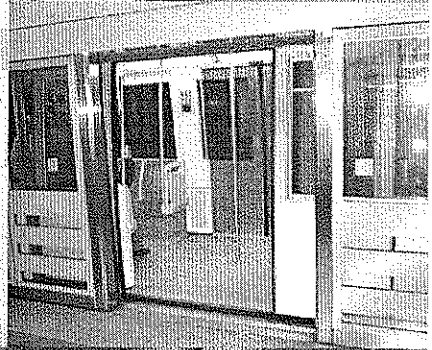


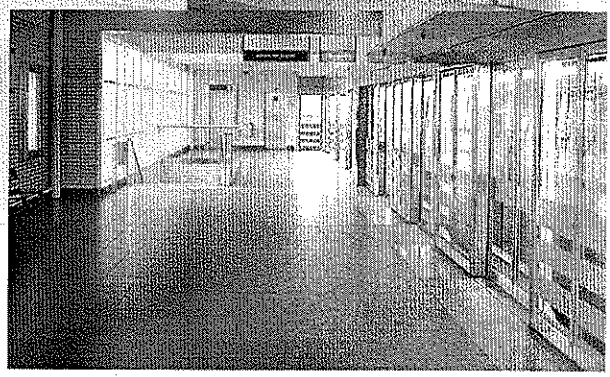
VAL and safety

The VAL system has been designed to ensure the highest degree of safety to the users, thanks to a series of characteristics:

- remote control of the service through the control and monitoring station (Posto di Controllo e Comando - PCC) located in the Collegno depot/workshop; the system works in a fully automated manner, but remote control and measuring devices are also available to enable the operators to take action on any train, at any point along the route, from the PCC;
- smoke detection and fire fighting systems, video surveillance, voice announcement system to inform the passengers;
- automatic platform doors at the stations, to ward off the risk of accidental falls;
- emergency catwalks in the tunnels along the entire line.

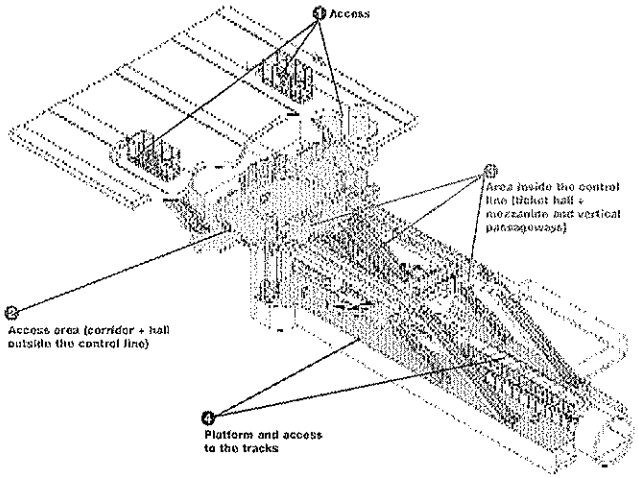
Thanks to the automatic control system, the trains can be operated without a permanent staff on the trains and in the stations.





6 Standard station

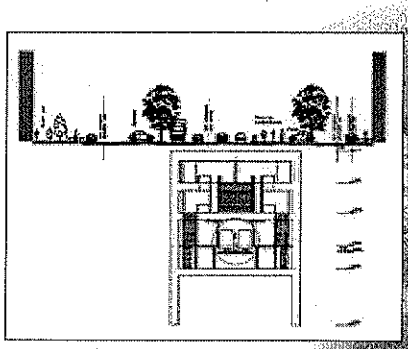
The Metro stations have been designed to offer a high frequency transport system with minimised waiting times. This objective is fulfilled by the interior layout of the stations, featuring rational lines of movement through the station, so that people can find their way around and get to the platforms fast and with ease; at the same time, safety and comfort are enhanced by the generously sized interior spaces, unobstructed by visual barriers. The design project of the standard station was worked out on the basis of the Architectural Chart drawn up by Bernard Kohn & Associés. It should be noted that the standard dimensions of the stations - 60 m long and 19 m wide - have been defined with a view to safeguarding the trees that line the city avenues (Francia, Bolzano and Vittorio Emanuele II).

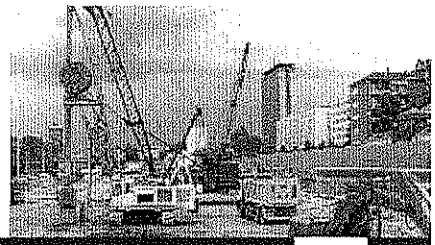


A station develops over four levels:

1. access (road) level,
2. hall and control line,
3. mezzanine,
4. boarding platforms.

Vertical connections are by means of stairways, escalators and lifts.





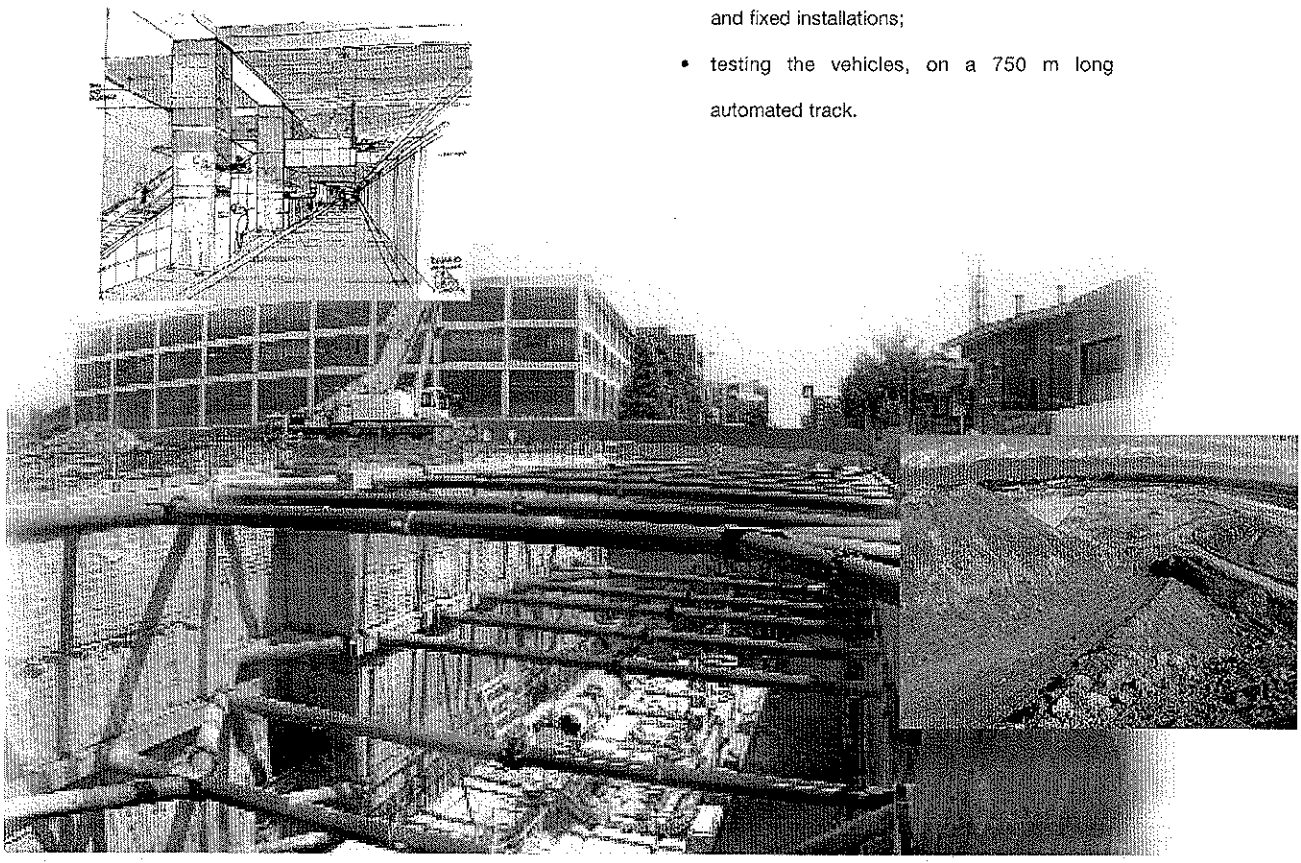
Exchange nodes and the Collegno depot

7

Some of the stations – Fermi, Porta Susa, Porta Nuova, Lingotto – also serve as exchange nodes with the other transport systems of the city and metropolitan area. Accordingly, these stations have specific functional and architectural requirements.

The depot/workshop, situated at the west end of the Collegno – Porta Nuova section, controls the operation of the entire line, through the control and monitoring station (PCC), and performs a number of additional functions:

- vehicle recovery;
- maintenance of the convoys, equipment and fixed installations;
- testing the vehicles, on a 750 m long automated track.



Building the stations

The stations of Turin Automatic Metro are created by "cut and cover", a method that envisages the following stages:

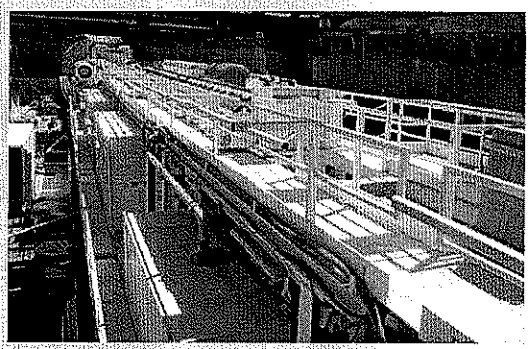
- preliminary operations, which consist of moving all the underground utility fixtures that stand in the way (sewer, water, telephone and energy lines);
- the next step consists of creating confinement walls along the entire perimeter of the station: these are reinforced concrete walls, from 0.8 to 1.2 m thick, approx. 3 m wide and 12 to 26 m deep. The excavation for bulkhead construction takes place by means of hydraulic cutters and buckets;
- having completed the construction of the bulkheads, the top beam is cast and the roof slab is formed leaving an opening to enable excavation works to be carried on internally;
- then, the interior volume of the station is excavated, the slabs at hall, mezzanine and ceiling level are cast;
- at this point, the TBM arrives, makes its way through the station and resumes the excavation of the tunnel;
- this is followed by the construction of the interior walls and the access facilities (fixed stairways, escalators and lift shafts);
- finally, finishing works are performed, and systems are installed together with safety apparatus.

10 Carving the tunnel

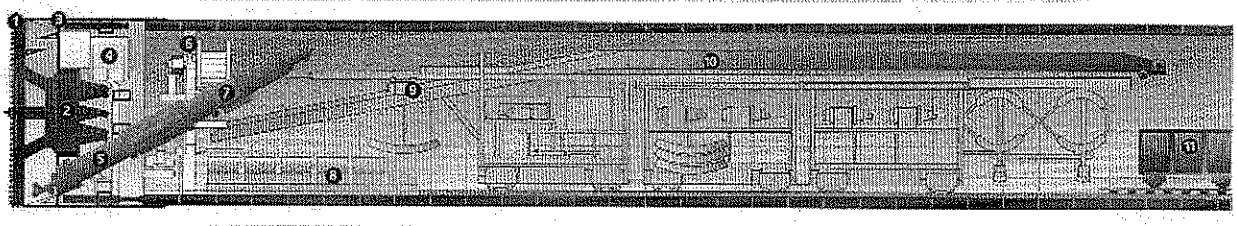
The tunnel between Fermi and Porta Nuova is carved under cover, by means of three Tunnel Boring Machines.

Each TBM is 7.80 m in diameter and ca 70 m long: the first 10 metres of the machine are taken up by a shield fitted with a cutter head rotating at a speed of ca 2 rpm and advancing at a rate of ca 10/12 m a day. The backup section of the machine, which is hooked to the shield, consists of a series of cars housing the control cabin, a conveyor belt to move away the rock chips (muck removal), a system to handle the lining segments (prefabricated concrete blocks lining the interior faces of the tunnel), electrical and hydraulic units, the supporting equipment.

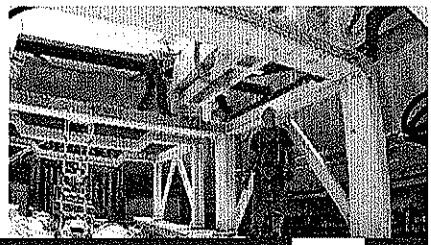
The layout of the tunnel does not interfere with the grid of Pietro Micca Tunnels dating back to the siege of Turin of 1706. Furthermore, digging takes place at a considerable depth - 15/18 m - to attenuate the problems associated with the noise and vibration produced by passing trains.



Simplified longitudinal view of a TBM



1	Cutter head	7	Muck outlet grid
2	Control unit	8	Segment handling system
3	Thrust jack	9	Segment elevator
4	Hyperbaric chamber	10	Conveyor belt
5	Worm screw	11	Material handling cars
6	Segment fitter		



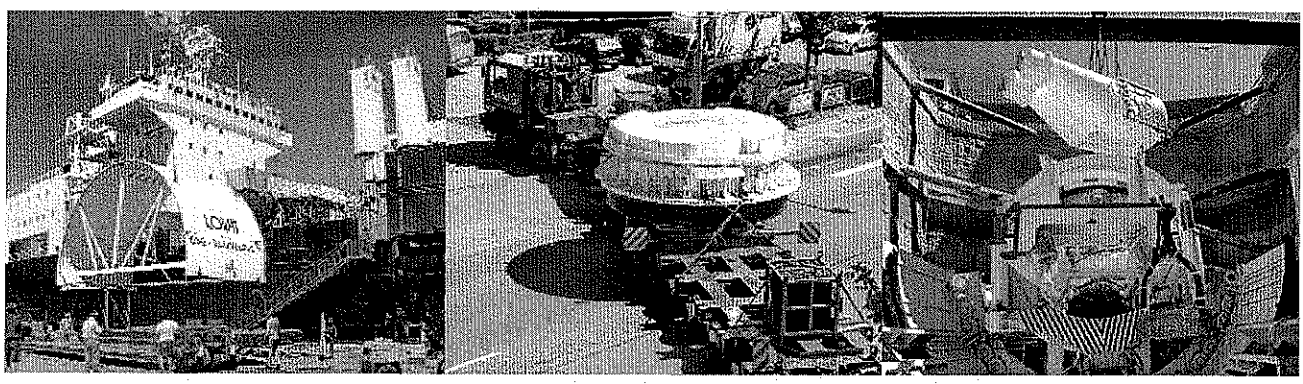
About the TBM

II

The TBM makes it possible to excavate the tunnels under cover and the same time place the interior lining of the tunnel:

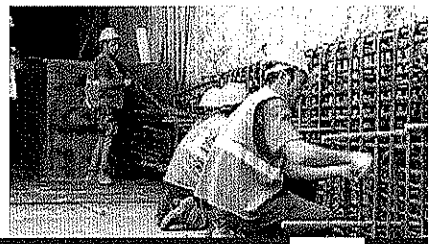
- once it gets to Turin aboard an unusual load vehicle, the TBM is lowered and assembled inside the station where the excavations works are to be started;
- the tunnel is excavated by the rotary movement of the cutter head and the machine moves forward by the thrust exercised by horizontal jacks (up to their full extension, of ca 150 cm) against the previously excavated tunnel walls;
- then, a new ring of lining segments is placed, and another cutting push begins. The excavation front is kept constantly under pressure by the machine itself;
- rock chips are removed by means of ad hoc (muck removal) conveyor belts, then a set of cars moving along the previously carved tunnel carries the material to a station whence it is pulled up to the surface;
- when the TBM has passed, the tunnel is virtually ready for the installation of the tracks, the technological systems and safety apparatus.

The first TBM has been lowered into the Fermi station and will be pulled up from the Pozzo Strada station; the second TBM will move in the opposite direction, east to west, from Pozzo Strada to Principi d'Acaja ; the third TBM will be lowered down into the Principi d'Acaja station in 2003 and will be extracted from Porta Nuova.



12 Figures of the Collegno - Porta Nuova section

Length	**9,600 m**
Stations	**15**
of which: exchange nodes	**3**
Hourly capacity, in each direction	**15,000 passengers**
Hourly capacity, in both directions	**30,000 passengers**
Train headway	**1' e 10"**
Actual headway at rush hours	**2'**
Travelling time from Collegno to Porta Nuova	**16'**
Scheduled service hours	**4:45 AM to 1:30 AM**
Technical data of trains:	
Max. capacity	**440 passengers**
Top speed	**80 km/h**
Turnaround speed	**32 km/h**
No. of trains	**33**
Depot/Workshop	**1 in Collegno**
Control and monitoring station	**1 in Collegno**



Names of Collegno - Porta Nuova section

Funds

Ministry of Transport	**60%**
Piedmont Region	**8%**
Commune of Turin	**25%**
Satti Spa	**7%**

Buyer

Satti Spa

Civil works - engineering

Design: ATI Systra Geodata

Architecture: AR THEME Architectes

Urbanistes Associés (B. Kohn - J. P. Vaysse)

System Technology: GEIE Transfima

(Fiat Engineering 51% - Siemens 49%)

Rolling stock: GEIE VAL 208

(Siemens 86%, Alstom Ferroviaria 14%)

Site Management

ATI Systra Geodata

Civil works - construction

Lot 1 – ATI: Consorzio Ravennate delle Cooperative di Produzione e Lavoro, Cogefa Spa

Lot 2 – ATI: VIPP Lavori Spa, Consorzio Ravennate (Cooperativa Ravennate Interventi sul Territorio - Iter)

Lot 3 – ATI: Grassetto Spa, Rodio Spa, Consorzio Cooperative Costruzioni, Garboli Conicos Spa, Cogefa Spa

Lot 4 – ATI: Grandi Lavori Fincosit, Seli Spa

Lot 5 – ATI: Grandi Lavori Fincosit Spa, Grassetto Spa, Seli Spa, Rodio Spa, Consorzio Cooperative Costruzioni Spa, Interstrade Spa, Cogefa Spa

TBMs

Lovat - NFM

14 *Building sites*

Satti Spa – Divisione Metropolitana
Corso Siccardi, 15
10122 Turin, Italy
Tel. + 39 011 5592 711
Fax + 39 011 5592 750
info@metrotorino.it
www.metrotorino.it

Graphics, editorial project and text

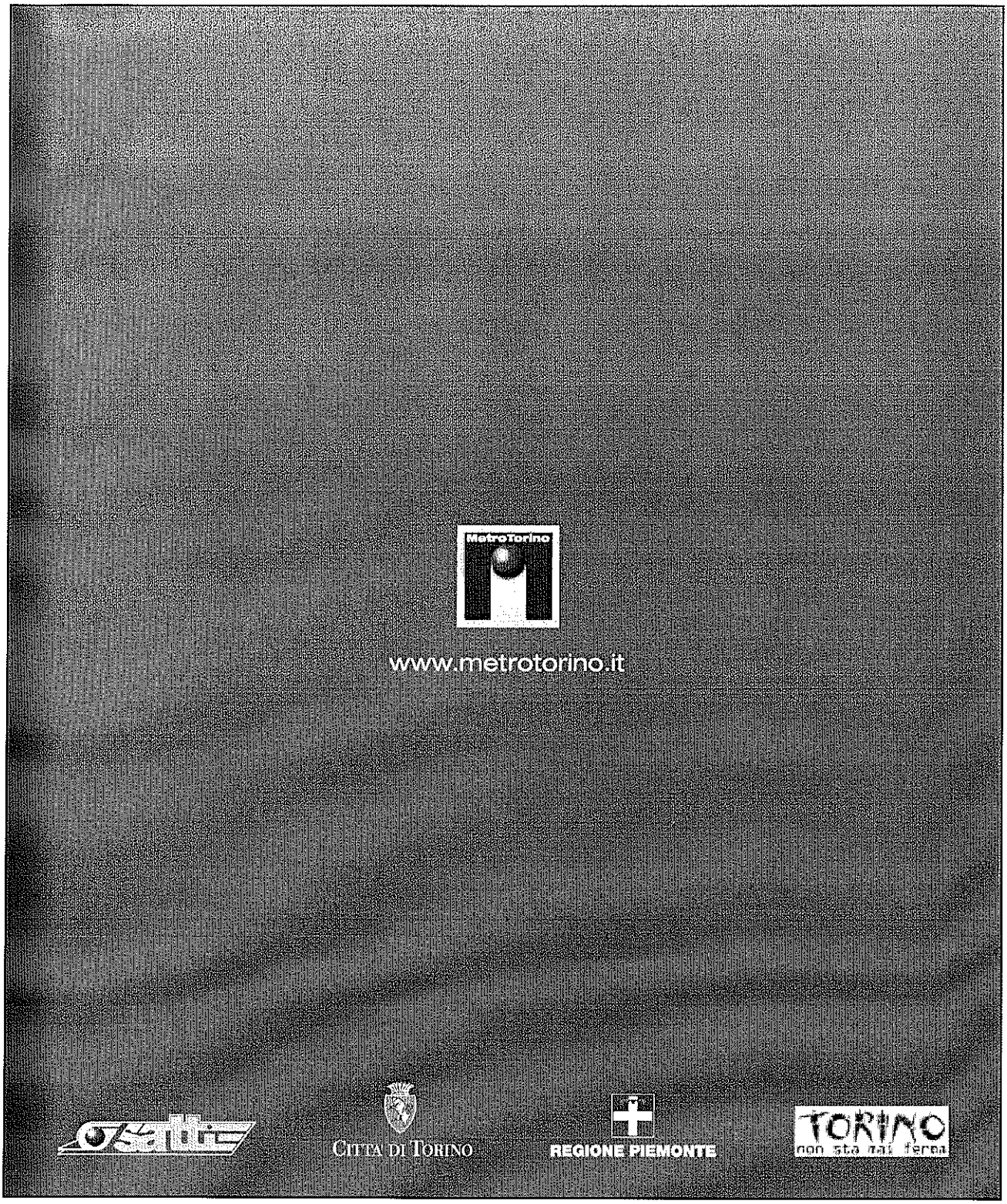
Grm Srl
Via De Sonnaz, 16/c
10121 Turin, Italy
Tel. +39 011 4407 643
Fax. +39 011 4542 014
grmtorino@grmsit.com

Printed by

Litografia Geda Snc

Credits for the images

Photos - Matra Transport International
Systra
Geodata
Photos - Giovani Fontana


MetroTorino
www.metrotorino.it
CITTÀ DI TORINO
REGIONE PIEMONTE
TORINO
non sta mai ferma