Recent Development and Utilisation of Underground Space in Italy

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ABSTRACT

The paper presents a concise description of the main undertakings already done in Italy in the last decade or presently in progress, involving the development and the utilisation of underground space and related to the following topics: urban mobility (metro and railway lines and stations, parking facilities), subsurface sections of new buildings, underground archaeology and geology, the Italy – France international railway tunnel (High Velocity Line – EU Corridor n. 5) and the new regulations and guidelines for underground urbanism.

1. INTRODUCTION

In recent years underground space utilisation has undergone in Italy a significant development, mainly in the framework of mobility related projects and urban renewal plans involving large areas that became available as a consequence of the displacement from central districts of huge industrial activities, mainly steel and chemical plants and city-gas works.

In this context, the utilisation of underground space is being a suitable tool to find solutions for the improvement of the quality of urban life through a better surface space arrangement and destination.

Mobility plans are including the construction not only of new railway and metro lines and stations but also of underground parking facilities.

Moreover, an increasing interest has been addressed to subsurface sections in new buildings, mainly for those hosting public functions like museums, exhibition centres, theatres and cinemas and commercial malls.

As in the past, considering the particular situation of Italy, several activities continued to be devoted to the urban underground space for geological and archaeological reasons.

Outside urban areas, the main project involving underground space is the new railway tunnel (about 53 km long) between France and Italy, belonging to the EU Strategic Railway Corridor n. 5, presently in the stage of preliminary works.

Finally, new Regulations - at national and local levels - have been made in the field of the planning of underground space (underground urbanism) in urban areas, mainly with reference to multi-purpose tunnels for city services (water, energy, telecommunications).

2. URBAN MOBILITY

In the last ten years, the underground space utilisation in the framework of urban mobility involved relevant projects that could be related to the following two sectors:

- the development of some metropolitan mass transit systems (metro lines and stations)
- the Railway Station Renewal Projects in some relevant nodes of the national network, associated with the new High Velocity Railway Network (TAV – Treno Alta Velocità).
The urban areas of Roma, Milano, Napoli, Genova and Catania implemented their existing metro systems, while in Torino and Brescia the first metro lines started to be built.

Fig. 1. New Metro systems.  
Fig. 2, 3, 4. Genova Mass Transit System, accesses to the stations.

2.1 Genova City Metro

Genova City is located on the very hilly sea-side. (fig. 2) As a consequence, its metropolitan mass transit systems is partly underground and include several tunnels and viaducts. Accesses to Metro stations are often problematic and required particular solutions (see figures 3, 4).

2.2 The Metropolitan Mass Transit System in Napoli

The Napoli’s City Transport Plan, the Plan for the Primary Road network and the modification to the General Master Plan have focused on accessibility to the city’s locations and activities rather that simply to mobility and involved, among other objectives, the renewal of conurbations, the enhancement of new green parks and the restoration of the historical centre. Fundamental tools for moving towards this direction has been the Project involving stations and interchanges of the Metro Line 1 (figures 5, 6, 7, 8, 9 and 10), a loop of about 40 km, with 25 stations - 8 of them serving as interchanges with other railways and 4 as intermodal cross-overs with primary roads.

Fig. 5 - 10. Napoli Mass Transit System, metro lines and stations, metro works

Fig. 11 - 16. Napoli Mass Transit System, metro lines and stations, metro works

Fig. 17, 18, 19. Napoli: New Metro line stations

Fig. 20, 21, 22. Napoli Metro station accesses and stations (proposed and existing)

A particular role has been plaid by the objective of architectural quality of the stations and by the simultaneous redesigning of the urban layout, around the stations themselves. This experiment of “public art” resulted in a series of “stations of contemporary art”, a new design of several squares and the creation of pedestrian zones, under the “motto” of Building stations: an opportunity for the city (figures 12 to 18).
2.3 The Brescia MetroBus

The Brescia mass transit system (MetroBus) (figure 23) includes underground and surface paths. Figures 24 to 26 show some details of the works and the standard station access in the underground section of the line.

Fig. 23, 24, 25 and 26. Brescia MetroBus: scheme, figures and station access details.

2.4 Torino Metro: the new line

The first part of Line 1 (blue line in figure 27) of the Torino Metro is 11 km long. The second part (red line) is presently under construction. The transport system, as in Brescia, (VAL) is fully automated. The characteristics of the architectural design are shown in figures 28 to 32.

Fig. 27. Torino Metro Line 1        Fig. 28 – 32. Station design with platform gate doors.

3. THE NATIONAL RAILWAY LINES AND STATION RENEWAL PROGRAM

A very relevant and expensive Program for the National Railway lines and station Renewal is presently under way in several cities, involving also a new siting of existing rails (from surface or trench-wise place to subsurface tunnels). In particular, the Companies owner of Central Stations in the main metropolitan areas (Milano, Torino, Roma, Napoli, Firenze, Bologna, ..) promoted international competitions for the design of new buildings, lines and auxiliaries infrastructures.

3.1 Torino City transformation

In Torino City, the lowering of the rail level, in the framework of the new arrangement of the rail crossing (the Passante) (figures 33 and 34) from the city borders through the main central stations, allowed to remove very hard barriers between central parts of the City, to make available for surface utilisation the space previously occupied by the trenches and resulted in the construction of a very large and long (about twelve kilometres) inner boulevard (“Spina Centrale” – Central Bone) (figure 35) crossing all the City centre and enhancing the renewal of the surrounding built environment.

Fig. 33 and 34. The “Passante” map and works.        Fig. 35. The Torino “Central Bone” Boulevard.
Fig. 36 to 39. Details of the design and works for Torino Rail Crossing and the surface architectural design of the new Porta Susa Station, where Rail and Metro are linked.

3.2 The high velocity train station in Firenze

A very innovative project for the station and accessory buildings of the new High Velocity Train has been approved for Florence (figure 40 to 44), a city where the integration with very singular surroundings requires particular care.

Figures 40 - 42. Florence Station design details. Fig. 43 to 44 show the proposed access to the micro-metro of Florence in a very sensitive environment.

3.3 The renewal of the Porta Garibaldi Railway Station in Milano

A large work site operated under the Porta Garibaldi Railway Station in order to obtain a better integration between road and rail mobility (figure 45).

Fig. 45. Milano Porta Garibaldi Railway Station and Crossing rail view.

4. PARKING FACILITIES

An example of innovative arrangement of underground parking in a hilly landscape is represented by the multi-storey facility for cars and busses built in Siena in an ex-industrial area. The parking should accommodate at least 800 cars and from 80 to 120 busses.

The following figures show two examples of innovative underground parking solutions, having the same general design approach: the “silo” structure.

Fig. 46. The multi-storey parking in Siena. Fig. 47. The Silo parking in Modena.

The figure 47 shows the silo parking built in Modena, while figures 48 to 53 refer to the city of Cesena. Referring to this last situation, the lift structure occupies the centre of the cylinder. It features a rotating steel tower with car-lift and an automated trolley for vehicle deposit and retrieval. The lift moves vertically while rotating simultaneously to deliver vehicles to the parking stalls. The only above ground construction is a pylon for receiving magnetic parking cards.
5. UNDERGROUND SPACE UTILIZATION IN NEW BUILDINGS

In the last decade an increasing interest has been addressed to a wider utilization of subsurface space for hosting auxiliary functions or user services in new buildings, mainly those devoted to public access. This interest resulted in several solutions involving museums, exhibition centres, theatres and cinemas and commercial malls.

Original solutions have been designed for another parking in Formia (figure 55 and 56) and for the Atalanta Soccer Stadium in Bergamo (figure 57).

6. GEOLOGY AND ARCHAEOLOGY UNDER THE CITIES

Beneath the streets of Napoli (as well as for many other cities and towns in Italy) there is a whole other city . . . a "Parallel City" as many call it.

Dating from the Greco-Roman periods, a literal honeycomb of interconnected tunnels, caverns, aqueducts, and huge voids left when volcanic tufo, a yellowish sandstone was excavated to build the city's palaces and villas. Modern-day urban speleologists conduct guided tours of many parts of this mysterious underworld (figure 58). The interest in these spaces suggested to find new but sustainable utilisations, specially those associated to tourism activities. Figures 59 to 63 show some of the more interesting proposals of integration between upper and under-ground space for tourism and leisure utilisations.

Fig. 58 The “Parallel” City of Napoli.

Fig. 59 - 63. Leisure space below ground.
7. INTERNATIONAL RAILWAYS TUNNEL

In last decades several underground road and railway works have been performed, but the most relevant one is the Torino – Lyon High Velocity Train Tunnel, that is belonging to the EU Strategic Railway Corridor n. 5, linking Lisbon to Kiev (figure 66). The present tunnel (14 km long) and the rail lines on both sides, that not allow to carry the planned good and passenger fluxes, will be substituted by new infrastructures, among which a very long (53.1 km) international tunnel under the Alps and some others quite shorter (10 – 12 km) in Italy, together with several viaducts. The system (which involves more than 80 km of works) is under construction and excavations are in progress ether in the France side as well as in the Italian one.

Figures 68 and 69 show the to profile of the infrastructure, while figure 67 show a pictorial view of the two channels and of auxiliary facilities.

The infrastructure is planned to be available in 15 years. Particular concern among the local communities is related to the environmental impacts during the construction of tunnels and viaducts as well as for the operation of the line. Additional impact analyses are being made in Italy for the evaluation of alternative solutions of the merge of this line into the Italian Railway Network where huge terminals are planned for the transfer of containers onto the train.

8. UNDERGROUND URBANISM REGULATIONS

In the last decade, new regulations (the so called PUGSS – Urban Plan for the Use of Underground Services and related Guidelines), both at national and local levels, have been promulgated with reference to the planning of underground space in urban areas, mainly with reference to multi-purpose tunnels for city services. The aim of these regulations is to force the adoptions, within Urban Renovation Plans, of multi-service tunnels, hosting several networks like district heating and cooling, drinking water, electricity and telecommunication lines, in order to obtain a more rational siting of these networks in the urban underground.

In the main Italian urban areas, initiatives aimed to include into the local Master Plans Regulations and Guidelines for the Underground Urbanism have been developed, but only a very limited number of works have been performed in the urban areas where renovations are taking place. Among the regional Administrations, the Lombardia local Government recently installed a board and built a legal framework for promoting the diffusion of these infrastructures. Initiatives involving also GIS tools have been promoted during National Meetings of Civil Engineers, Urban Planners, Architects, Administrative Staffs, Software producers and construction Companies.

REFERENCES