

Metropolitana di Roma - Linea C

HISTORY BUILDS THE FUTURE

Project Profile

A work that "makes history"

Metropolitana di Roma - Linea C project will provide the city of Rome with cutting-edge infrastructure in the area of mobility. **Many different stories travel and will travel on Line C:** from those related to its conception to those of the various stages of construction; the stories of those who built it and those who use it every day. Many small stories **that are changing the future of Rome.**

It is the story of a work, and the story of Rome, the spirit of its past and the vision that is building its future. Its **a modern subway**, serving a city that is more than a city, it is the Urbe, the **capital of Italy** that cannot do without strategic and excellent infrastructure.

The construction of such a work represents an engineering challenge. **The soil of Rome is, due to man-made characteristics, unique in the world:** a city alive and at work for over 3,000 years where **the testimonies of civilizations, eras and generations** that have followed have remained, and are part of our history, our heritage. In creating Line C, **the challenge is to build a work that is fundamental for the present and for the future, while respecting the past.**

The line and its stations

The line **crosses Rome**, linking the city from the South-East to the North-West, **connecting the suburbs to the centre.** It passes through historic districts of the city such as Centocelle, Pigneto, Appio Latino and the historic centre, to then arrive at the Prati district near Piazzale Clodio. **It is 26 km long**, 17 underground and 9 on the surface, for a total of **29 stations**, from the stop at Monte Compatri/Pantano to Clodio/Mazzini.

The execution of the project is proceeding in functional segments. At the moment, **the section that runs from the terminus in Pantano**, in the municipality of Monte Compatri, to San Giovanni, towards the centre, has been completed and is already in operation: a **19 km route, with 22 stations and 1 workshop** depot already in operation.

The next connected stations will be Porta Metronia, Colosseo - Fori Imperiali and Venezia, in the historic centre, currently under construction, while the remaining stops – Chiesa Nuova, San Pietro, Ottaviano and Clodio/Mazzini are in the planning stage.

The project also includes **4 line transfer stations:** with line A in the stations of San Giovanni and Ottaviano, with line B at the Colosseo stop and with the local railways FL1/FL3 at the Pigneto stop.



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Project figures

From Monte Compatri/Pantano to Clodio/Mazzini

26 km of line 17 underground and 9 on the surface

29
stations

22
stations completed

3
stations under construction

- Venezia
- Colosseo-Fori Imperiali
- Porta Metronia

4
stations in planning

19 km
operating from the station
Monte Compatri/Pantano to San Giovanni

800,000
people per day
(maximum capacity)

4
connections with existing lines
(Metro A - San Giovanni and Ottaviano |
Metro B - Colosseo | FL1/FL3 - Pigneto)

over
1,500
supplier companies
(98% Italian)

How the future is built

To create a large complex work in a single area, it was necessary to choose with a great deal of **attention and preparation the excavation and construction techniques most suitable to the context.**

Different techniques for excavation

The excavation of the tunnels was carried out using **two methods, traditional excavation and mechanized excavation with the use of a TBM** (Tunnel Boring Machine). By virtue of the historical and structural constraints of the area, the use of one technique or the other was carefully studied on the basis of the engineering needs and the terrain.

There are four TBMs (EPB - Earth Pressure Balance type) being used for mechanized excavation. **TBMs are state-of-the-art excavating machines** that support the excavation face and line the tunnel, making it ready to be equipped and operate with considerable time savings.

Sacrificial diaphragms and freezing

During the works, **various cutting-edge techniques were used** precisely in order to combine the effectiveness and safety of the excavations with the historical and monumental needs of the context in which the work stands.

An example is **the technique of sacrificial diaphragms**. Used for the first time in Rome and in Italy, they allow the excavation works to be carried out while preserving the historical and artistic heritage of the city. The diaphragms are walls of non-reinforced concrete, perpendicular to the perimeter walls, which, having fulfilled their role as supports, are demolished as the excavations of the station proceed.

Another solution used is freezing, a ground consolidation technique which involves the construction of a **protective wall of frozen ground** within which the tunnel excavation and lining construction operations are carried out. **This technique represents the most appropriate choice when operating in urban environments with very permeable soils** because it guarantees the highest possible level of safety.



Build the future, add value to history

The engineering challenge for the construction of Metropolitana di Roma - Linea C runs on the same tracks as another challenge, that of **preserving and enhancing the cultural heritage of the city**, whose historic centre has been recognised by UNESCO as a **World Heritage Site** since 1980.

The project **changes the paradigm that often accompanies construction in Rome: the past is not an impediment but a value**, and the realisation of the work becomes a unique opportunity to promote unique finds.

Studies for the protection of archaeological heritage

The construction of the stations on Line C took place with the **constant collaboration of the state and municipal Superintendence Offices**. This continuous and virtuous exchange resulted in a **detailed program of investigations** which made it possible to identify numerous finds and to update the archaeological maps in areas that have not yet been investigated.

Along the route from the Pantano terminus to the San Giovanni station, **29 archaeological sites were explored**. The first important find emerged in the area of the Monte Compatri/Pantano terminus: the remains of a village dating back to the Neolithic age. In the central area, along the stretch from via Sannio to piazza Venezia, and along the stretch from piazza Venezia to piazzale Clodio/Mazzini, a further 22 construction sites with archaeological excavations have been opened for preventive investigations, some of which have yielded important results.

History and future, therefore, have often met in the same excavation. The operation has taken on a double meaning: both the construction of a present and future work, and an opportunity to explore the richness of the past. **In agreement with the Superintendency of Rome, a document was drafted and a specific procedure prepared** to combine the progress of the works with respect for the archaeological assets still buried. This document is named the "Handbook of second phase archaeological investigations" **and is the first document of its kind ever prepared in Italy**.

Top-down archaeology

As part of this fruitful collaboration, the **archaeological excavation technique was refined with the "top-down" methodology**. This is an innovative excavation technique, designed **to combine the need to carry out open-air archaeological excavations** up to a depth of 18-20 m from ground level **with the need when building to limit the construction site areas**.

In fact, the top-down archaeological method calls for the construction of intermediate floors in a downward direction and guarantees the possibility of carrying out archaeological excavations at the same time as the construction of the floors, with benefits in terms of optimization of construction times and occupation of space by the construction site.

During the excavations, **over 500,000 finds were recovered**, 4,000 in the San Giovanni station alone, which was transformed into an **"archaeo-station", a genuine station-museum** characterised by display cases and exhibition areas with finds and information inserts on the wall. This solution also became a model for the other stations under construction.

Venezia station, a new museum centre

The first phase archaeological investigations carried out in Piazza della Madonna di Loreto made it possible to bring to light a monumental complex of exceptional importance: the **Auditoria of Hadrian**, consisting of large halls where philosophical discussions and public readings of literary works took place. Also in this case, a **unique and specific design of the station was envisaged which will incorporate the find with a special installation.**

Archaeological investigations in the centre of the square have revealed **the wall structures of the ancient *tabernae***, buildings for commercial use, which overlooked the Via Lata, the ancient Via Flaminia. They will also be relocated at the end of the work to be exposed to visitors.

The station will create a true museum centre to travel through history, providing an **underground connection via the first underground level of the station with the museums of Palazzo Venezia, with the Vittoriano and with the Foro di Traiano.**

Colosseo - Fori Imperiali, the station of wells

During the second phase of archaeological excavations where the Colosseo - Fori Imperiali station will be built, many materials and finds emerged in an excellent state of conservation, evidence of the extraordinary continuity of life from the archaic age to the medieval age in the valley area of the Colosseum.

The Colosseum Archaeological Park therefore requested that a specific installation be **provided at the end of the second phase archaeological excavations. The installation was designed in collaboration with the Faculty of Architecture at the University of Rome "La Sapienza"** and involves the repositioning of a part of the ancient structures inside the station and **the reproduction of some of the wells found during the excavations.**

A barracks at Porta Metronia

During the excavations for the Porta Metronia station a discovery was made which in terms of importance and state of conservation is **among the most extraordinary in Rome in recent years. It is a barracks dating back to the time of emperor Hadrian.**

The remains of the walls and floors allow us to imagine the entire construction: **39 rooms along a central corridor**, according to a recurring pattern in the quarters of the barracks of the Roman world. Near the barracks, a domus was also found which was called **the "Domus del Comandante"**. On the floor of these buildings **mosaics in excellent condition were found.**

To safeguard the finds in this case as well, a project has been envisaged to enhance them with a special installation. To do this without compromising the progress of the work, **it was decided that all the finds would be removed, restored and then put back in their original location.**

Constant monitoring

Along its route, **Line C interacts with historic buildings and monuments** of great value located on the surface, such as the Colosseum, the Basilica of Maxentius or the Vittoriano. **To ensure the preservation of this heritage, an study of the interaction with monuments was developed, which involved 13 sites and 40 historic buildings.** At the same time, constant monitoring of the buildings was started, in order to verify the correspondence between the design forecasts and the acquired data and measurements. In fact, **an agreement has been stipulated with the Department of Geotechnical and Structural Engineering at "La Sapienza" University** for structural analyses of the soil from which 2D and 3D models have been developed.

Monitoring continues during construction, through analysis models that allow for further study of the project. An ad hoc monitoring system which makes use of an SDD platform was implemented for this purpose, specially calibrated and developed for Line C. Process automation allows comparison with previously collected data, ensuring reliability and speed.



Building a future of innovation, development and sustainability

The driverless system

Metropolitana di Roma - Linea C makes innovation run. Among the important technological elements is the **driverless system**, which is already being used in all the stations in operation. Driverless technology, or more specifically the Integral Automation System, **manages all vehicle functions remotely**, without a driver being on board. Everything is managed by the command centre, called the **Central Operations Directorate (DCO)**, which is both the heart and the brain of this system, and which is **located at the Graniti Workshop-Depot** in an area of approximately 210,000 m². From Central Operations to the trains, another small record: the driverless trains of Line C are **the longest highly automated trains in Europe**, at 109,4 m in length.

The benefits of the line

The Line C has represented **an opportunity for development right from its creation**. First of all economic development: since the beginning of the work, **the project has involved around 1,500 suppliers**, with a supply chain rooted in our country - around **98% of the companies involved are Italian**.

The work contributes to **making Rome more accessible, mending the fabric of the city from the south-eastern periphery to the centre**, fully integrating into the public transport system and generating a real **"network effect" for Rome's mobility**. For a **more liveable and connected city, with close, widespread and easily accessible stops**, serving individual neighbourhoods.

In particular, Line C **will make it possible to transport up to 800,000 passengers per day**, i.e. potentially **24,000 users per hour in each direction**.

Studies developed in collaboration with the University of Rome Tor Vergata¹ estimate that the use of the line will lead to significant results:

-25,000 km
private transportation per year

-3,000 hours
private transportation per year

-1,800 accidents
on the road

-4,700 hours
public transportation
per year, during rush hour

¹Evaluation study of the economic benefits from traffic associated with the construction of Metro C in the current operating configuration, University of Rome Tor Vergata, Department of Engineering, 2017

The line of sustainability and urban regeneration

Once the underground works have been completed, the surface areas affected by the construction sites are gradually returned to the citizens, renewed and redesigned. And **the external arrangements of stations and wells are designed to create meeting places that can be used by citizens.**

For example, **the Giardinetti station has also been completely renovated** on the surface. It has a distinctive shape reminiscent of a trapezoid with large windows and features a car park with more than 200 parking spaces. Further on, **the Teano station has been equipped with a large atrium that can be used for events, exhibitions and various cultural initiatives.** The Malatesta station is characterised by a **central open-air underground space intended for commercial, cultural activities and events:** a true meeting and socializing place at the service of the neighbourhood.

Line C is a line that builds sustainability. During the work, **ample space has already been given to green areas in the city: around 98,000 m² of green areas were created in the project and over 4,300 new trees were planted.**

An example of a green area linked to the work on Line C is the **gardens of via Sannio**, where the construction of the ventilation shaft was also an opportunity to give back to the city **a green area of 9,500 m²**, close to the Aurelian Walls. In the redevelopment of the gardens, **the remains of the imposing portico built during the Empire of Claudius**, which was found during the excavation activities, was displayed on the surface of the green area.

The line will also have a big impact in terms of future sustainability. **A reduction in CO₂ emissions of approximately 310,000 tons per year is estimated for the entire line.**

Some of the solutions used in the construction of Line C could become **a reference benchmark** for the engineering of public works in complex contexts from an anthropic and cultural point of view.

A work that, in every respect, is already capable of building the future.



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