URBAN TUNNELS. THE BARCELONA EXPERIENCE

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1. Barcelona ring roads and the tunnel system.

2. Urban integration of the *Ronda del Mig* (1st ring).

3. Safety in the urban tunnels: La Rovira.


5. Urban tunnels in the future of Barcelona.
Since the Olympic Games in 1992, Barcelona has developed a great urban transformation.

Creating a high capacity road network: “The Barcelona Road Rings and Tunnel System”.

First Ring *Ronda del Mig* and *La Rovira* tunnel complement the road network.

Several tunnels are now being designed, improving this infrastructure, in order to develop the High Speed Intermodal Station of *La Sagrera* and *La Plaza de las Glorias Catalanas*. 
The 8 tunnel boring machines of railway tunnels
1. Barcelona ring roads and the tunnel system

Presently the road rings are improving the performances

Geographical Information System (GIS)
New Centralize Control System of the rings (SCC)

The tunnels are improving the standard of safety

Source: Google
1. Barcelona ring roads and the tunnel system

Authorities in charge of the ring roads (Rondas) management

| TITULARITIES                        | Barcelona City Hall  
|                                     | Generalitat de Catalunya  
|                                     | Ministry of Public Works  
|                                     | Sant Adrià City Hall      |
| INFRASTRUCTURE MAINTENANCE          | Consell Comarcal del Barcelonès  
|                                     | Barcelona City Hall  
|                                     | Ministry of Public Works  |
| MAINTENANCE AND MANAGEMENT OF TRAFFIC SYSTEMS | Barcelona City Hall  
|                                     | Servei Català del Trànsit  |
| AUTHORITY OF TRAFFIC                | Guàrdia Urbana de Barcelona  
|                                     | Mossos d’Esquadra           |
1. Barcelona ring roads and the tunnel system

Rings Road tunnel length 8,5 Km.
Ronda de Dalt = 166.000 (IMD 2008)
Ronda Litoral  = 108.000 (IMD 2008)
2. Urban integration of the Ronda del Mig (1st ring)

Urban Tranformation of the Road Network

**Horta-Sants** (Old Ronda del Mig of Barcelona) with tunnel and pacified areas network:

Cerdà Square viaduct demolition, Badal and Mitre tunnels, pacified area between Vía Augusta and Lesseps, Lesseps underpass, pacified area until Camelas, Camelas tunnel, demolition of the Alfonso X viaduct and improvement of Rovira tunnel. Urban tunnels improvement: optimize the interdependency and adaptation to specific regulations: La Sagrera Station and Las Glorias Square.
2. Urban integration of the *Ronda del Mig* (1st ring)

**Road network: Horta - Sants**

- Lesseps Square
- Ronda del Mig between Escorial and Vía Augusta
- Ronda Guinardó
- La Rovira Tunnel
2. Urban integration of the *Ronda del Mig* (1st ring)

- Main viaduct (283 m length, 12.5 m width)
- Access branch from La Rovira tunnel (112 m length, 7.5 m width)
- Upper pass in Padilla Street (46 m length, 12.5 m width)
- Cantilever retaining wall between Padilla and Cartagena Street (200 m length, 4.5 m width)
3. Safety in the urban tunnels: La Rovira

“The icing on the cake” of the Ronda del Mig urban transformation is La Rovira Tunnel (connection between both ring roads)

Recently, several studies and projects have been developed, improving the Standard of Safety.
3. Safety in the urban tunnels: La Rovira

Standards of Safety improvements

Adaptation of the La Rovira installations as per regulations.

- First Phase: Protection Systems and safety and Centralized Technical Management
- Second Phase: Ventilation, energy and lighting
- Installation of panels and side wall painting
- Installation of a new white concrete pavement

Approximate length: 1.300 m

Finished work.
Investment: 11,4 M€
4. Design, organizing aspects and safety improvements

Objective
To design safe, convenient and functional tunnels.

Conception and Design. Regulations

Tunnels design following International, National and regional Standards and Recommendations.

4. Design, organizing aspects and safety improvements

**Conceptual design**
Choosing number of unidirectional or bi-directional tubes

**Roadway Shoulders**
When designing opening width of the platform not jeopardize the demands of future traffic
4. Design, organizing aspects and safety improvements

Tunnel low point. Study connection with existing or new sewage collection system and capacity

**Design of installations for the evacuation and protection of users**

- Access points every 200 meters
- Direct connections to exterior whenever these are feasible under reasonable reasons
- Connections between twin-tube tunnels.
4. Design, organizing aspects and safety improvements

Study of the road network at tunnel access

- Study of the design of the roadway tunnel access, taking into account characteristics and capacities
4. Design, organizing aspects and safety improvements

Extraction of fumes in “comfort” conditions and in case of fire

- Solutions for ventilation in the “comfort” mode and in the event of fire inside the tunnel
- All fans must be reversible
- Compatible with a design solution with openings in the roof of “naturally”
4. Design, organizing aspects and safety improvements

Air and noise pollution in and around Tunnels

Air Quality

- Treat the exhaust air from the tunnel and minimize concentrations of substances hazardous to the health of people living nearby
- A proposal for improving air quality could be to install a filter system
4. Design, organizing aspects and safety improvements

**Control and management of tunnels**

Coordination and centralization of all the safety systems of the tunnel, in addition to traffic management in its area of influence.

**Proposal for a urban tunnel management model**

Tunnel management. Ensure functioning in normal use conditions and in case of accidents. Create organizations dependent on the highest authority unifying all tasks related to tunnel management with professionals for each task and specific means required for response in case of extreme-risk situations.
4. Design, organizing aspects and safety improvements

Proposal for a urban tunnel management model

Tunnel Manager, as the highest authority, should depend directly upon the maximum municipal authority for operational purposes in emergency situations.

The entire tunnel management must be subjected to systematic technical audits.
5. Urban tunnels in the future of Barcelona

High Speed Intermodel Station of *La Sagrera* and *La Plaza de las Glorías Catalanas* Tunnels
5. Urban tunnels in the future of Barcelona

High Speed Intermodel Station of La Sagrera

• Length = 6,3 km (unidirectional tubes, 2-3 lanes)
5. Urban tunnels in the future of Barcelona

Plaza de las Glorias Catalanas road tunnels
5. Urban tunnels in the future of Barcelona

Plaza de las Glorias Catalanas road tunnels
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OBJECTIVES

• Improve Urban Tunnels Management Coordination
• Integrate cartography and documentation “as build”
• Develop an specific Regulation for Urban Tunnels construction and Management following the Spanish and International Regulations
• Develop specific management system for each tunnel and a Tunnel Control Centre

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