Appendix 2.7 - FRANCE – Annecy – Tunnel Courier

1. TRANSIT TUNNEL AND ACCESS TO UNDERGROUND PARKING LOTS

The Courier tunnel is located in Annecy (France), a city of about 55,000 inhabitants and the centre of an urban area of about 150,000 inhabitants. The population of this area doubles during the summer season. The Courier tunnel is situated down-town (**Figures 1 & 2**). It has a dual function, first to allow the transit traffic underneath a large pedestrian area and secund to give access to underground car parks (capacity of 2,000 places) that are associated with a mall, a multiplex of cinemas, buildings for housing, as well as public spaces.

Figures 1 & 2 – Courier tunnel – pedestrian area

The Courier tunnel is owned and operated by the city of Annecy.

The tunnel has been open to traffic since March 2001. It includes two tubes each with two unidirectional lanes. The East-West tube is 590 m long. The West-East tube is 380 m long (**Figure 3**). Accesses to the car parks (entrance and exit) have a global length of 220 m.

The two tubes are partially built one above the other. They border a rail tunnel giving access to the railway station.

They are linked to the road networks at the surface by roundabouts.

The accesses to the tunnel portals are covered with glazed galleries improving the integration in the urban space and providing noise protection (**Figures 4 and 5**).

The West-East tunnel gives access to underground car parks**,** arranged on two levels. Other accesses are also provided from the surface road networks.

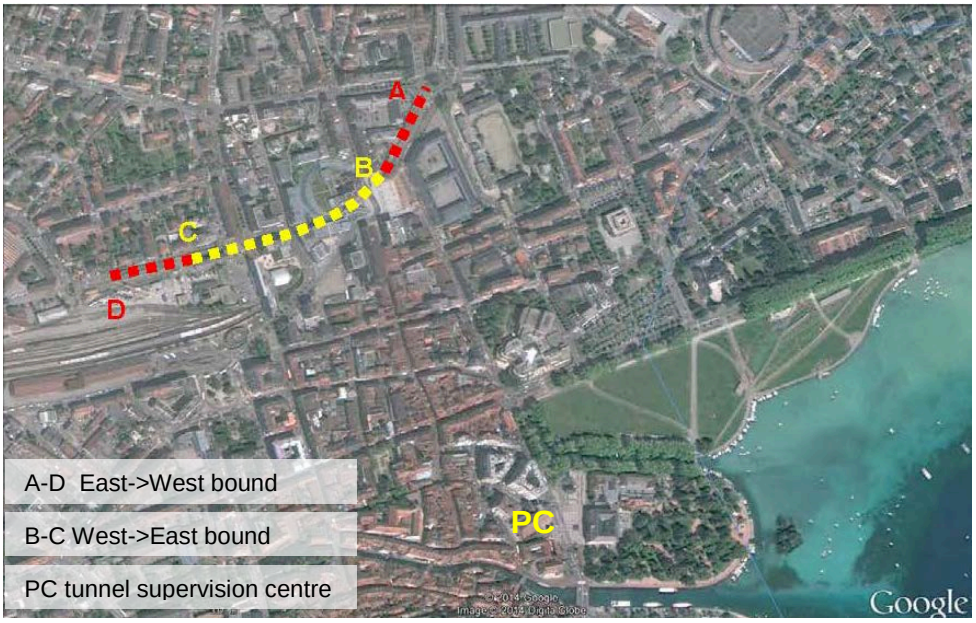


Figure 3 – location of the Courier tunnel

The tunnel has been constructed using a cut & cover construction method inside slurry walls. The buildings of the mall and the cinemas multiplex are constructed above the tunnel.

Figure 4 – Eastern portal W-E bound

Figure 5 – western portal E-W bound

2. MAIN CHARACTERISTICS

2.1. GEOMETRY

- Tunnel length: 590 m and 380 m,
- Horizontal alignment with a minimum curve of 100 m,
- Vertical alignment maximum gradient of 8%.

2.2. CROSS SECTION

- 2 lanes 3,00 m width in each direction,
- Sidewalks of 0,75 m width,
- Vertical clearance of 3,20 m for the transit tunnels and 1,95 m for the accesses to the car parks,
- Access prohibited to trucks and to dangerous goods,
- Traffic speed restricted to 50 km/h for transit tunnels and 10 km/h for the accesses to parking lots.

Cross sections are shown in the sketches below. Transit tunnels are superimposed except in front of the accesses to the car parks as shown **figures 6, 7 and 8** below.

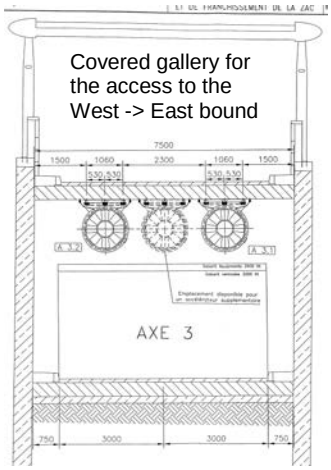
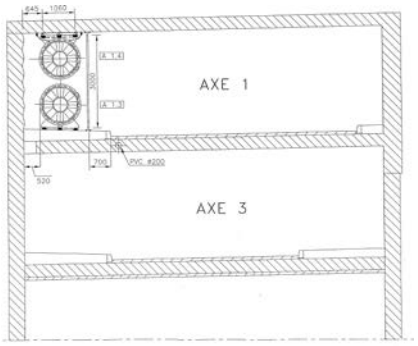


Figure 6 – typical cross section of the access to the West -> East tunnel



Legend: - axe 1: West -> East tunnel
- axe 2: access to car parks
- axe 3 : East -> West tunnel

Figure 7 – typical cross section of the transit tunnels

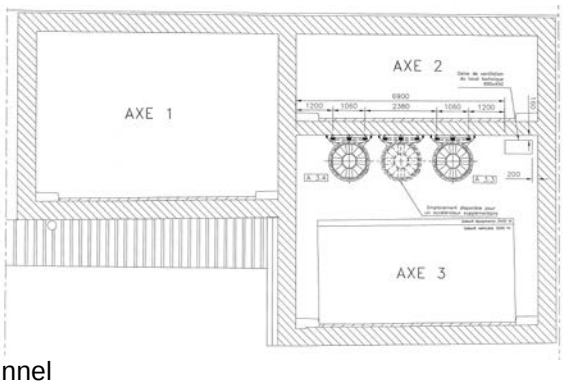


Figure 8 – typical cross section on the accesses to the underground car parks

2.3. TRAFFIC, BREAKDOWNS AND ACCIDENTS

2.3.1. Traffic conditions

- West -> East tunnel: AADT (annual average daily traffic): 10,600 veh. / day. Peak hour traffic 1,050 veh. /h. Temporary traffic congestion appears daily with queuing caused by the roundabout for the connection to the surface road network. A particular operational mode and procedure 'traffic jam' is then introduced to manage the traffic and to mitigate the risks inside the tunnel,
- East -> West tunnel: AADT 3,300 veh. / day. Peak hour traffic 450 veh. /h.
- The imbalance of the traffic between the two directions results partially from the fact that West->East tunnel gives access to the parking lots.

2.3.2. Breakdowns and accidents

- Annual average of 15 breakdowns, including vehicles that temporary stop that resume their journey without the intervention of the operating services
- Annual average numbers of accidents:
  - About 7 oversize vehicles (caravans/campervans),
  - 2 traffic incidents between vehicles without serious consequences,
  - 2 skids on ice,
- No fire has occurred since the tunnel has been opened,
- No accidents resulting from traffic congestion and queuing inside the tunnel.

2.3.3. Escape routes

The tunnel has five escape routes giving direct access to the outside via stairs. In order to optimise the use of space, the escape routes are combined with the pedestrian accesses to the car parks.

2.4. ENVIRONMENTAL MEASURES

2.4.1. Air quality

The tunnel is authorised for personal cars only. The pollution emissions are consequently reduced. The discharge of polluted air is shared between the two portals according to the traffic volume and the climatic conditions.

2.4.2. Noise nuisances

The jet fans are fitted with noise attenuators. The accesses to the tunnel portals are covered and partly closed.

2.4.3. Water quality

Water is collected in tanks located at the lower point of each tunnel. The tanks are fitted with oil separators. The drainage system is equipped with fire traps. Polluted water, of low volume, is pumped and discharged to the urban sewerage network. The pumps are explosion protected.

2.5. SAFETY AND OPERATING EQUIPMENT

The two tunnels are equipped with the usual safety and operating equipment. Particular attention has been paid to the systems for communication with tunnel users, to traffic management and to the safety conditions, as well as to the environmental measures: numerous detectors, CCTV, AID (automatic incident detection), traffic loops, cables for temperature detection, radio communication and size control of the vehicles in front of the portals, remote motorized barriers for closing the entrances, etc.

3. INTERFACES WITH THE UNDERGROUND CAR PARKS

The West-East tunnel gives access (entrance and exit) to the private and public car parks located underneath the mall and the cinema multiplex.

It creates numerous interfaces between the two facilities of different natures and functionalities. The following measures have been implemented in order to manage the interfaces and assure the safety of the road users, the mall customers, the cinema spectators and the residents of the surrounding buildings.

3.1. UNDERGROUND PARKING FACILITIES

The West -> East tunnel (**figure 8 axe 2 and picture 10**) gives access to the underground car parks. The South car park (200 places) is located at level -1; the North car park (1,800 spaces) is organized on two levels (n-1 and n-2). The North car park can also be directly reached from the surface road network without using the tunnel.

Figure 9 – view of the exit from car park

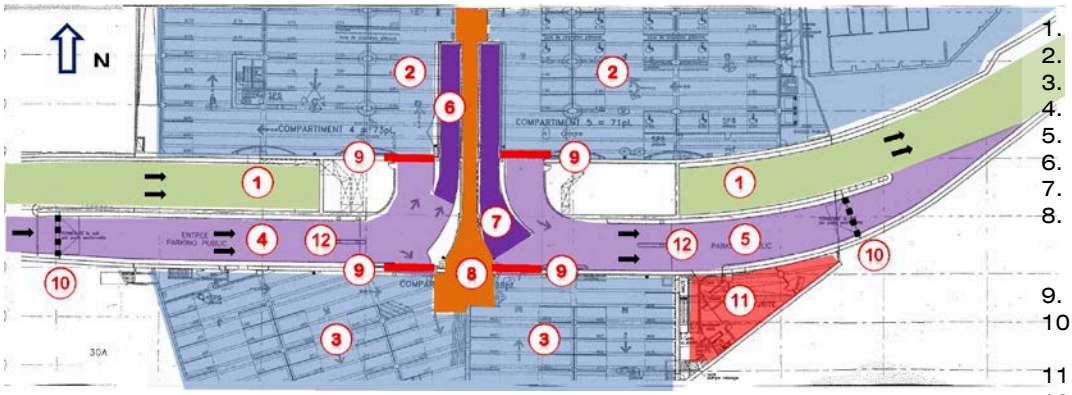
Figure 10 – car park entrance

The exit from the transit tunnel in the direction of the car park entrance (**Figure 10**) has a single lane, as does the exit from the car park to the tunnel (**Figure 9**). Considering the speed limits (50 km/h inside the tunnel and 10 km/h

for entrance and exit) the exit lane to the car park is about 50 m long (**Figure 10**), while the merging lane to the tunnel (**Figure 9**) is about 30 m long (available space limited by the presence of the existing rail tunnel).

The car park access and the exit have two lanes equipped for control and tolling.

The general concept for accessing the car parks is shown in **figure 11** below (car parks are partially represented only). The East ->West tunnel is not shown; it is located on a lower level as shown **figures 7 and 8**.



1. West ->East tunnel
2. North car park level -1
3. South car park
4. Entrance toward car park
5. Car park exit
6. Access to level -2 North car park
7. Exit from level -2 North car park
8. Closed pedestrian gallery linking North and South car parks
9. Fire proof door
10. Control door on the car park accesses
11. Car park supervision centre
12. Toll booths

Figure 11 – sketch of the car parks and their accesses

3.2. VENTILATION

3.2.1. ventilation of the transit tunnels

Transit tunnels have a longitudinal ventilation system. Ventilation is provided by jet-fans located either in the ceiling, or in side niches depending on the available space. The jet-fans are reversible so as to be able to satisfy multiple ventilation scenarios.

The ventilation system is automatically managed by the SCADA system on the basis of scenarios predefined for normal traffic conditions, emergency conditions, fire conditions or the environmental constraints. The objective is to guarantee the safety and the health of tunnel users, as well as the residents, while optimising the operating conditions.

3.2.2. ventilation of the car parks

The ventilation installations for the car parks are fully independent of those of the tunnels. They include fresh air intakes, polluted air and smoke extraction vent, as well as a network of metallic ducts. Ventilation facilities for the car parks are automatically managed by their own control system.

3.2.3. Procedures in case of fire

- Fire inside a car park. Closure of the fire doors (**Figure 11 – mark 9**) isolating the car parks. Extraction of smoke by the ventilation system for the car parks. Closure to traffic of the West->East tunnel,

- Fire inside the East->West tunnel (axe 3). This tunnel has no interface with the car parks. The tunnel jet-fans are activated to push the smoke in the traffic direction. The jet-fans of the West->East tunnel are activated in the opposite direction of the traffic in order to prevent smoke recirculating between the two tunnels at the West portals,

- Fire inside the West->East tunnel or inside the tunnel giving access to the car park. Several scenarios may be implemented according to the position of the fire. The general concept is shown by the sketch (**figure n° 12**) below: (i) closure of the fire doors in order to isolate the car parks from the tunnels – (ii) activation of the ventilation of West->East tunnel in the traffic direction – (iii) activation of the ventilation of the other tunnel in opposite direction from the traffic in order to avoid recirculation of the smoke at the East portals – (iv) activation of the jet-fans located above the closed pedestrian gallery (**Figure 12 and Figure 11, mark 8**) in order to assure the longitudinal air flow inside the access and exit tunnel to the car parks (axe 2).

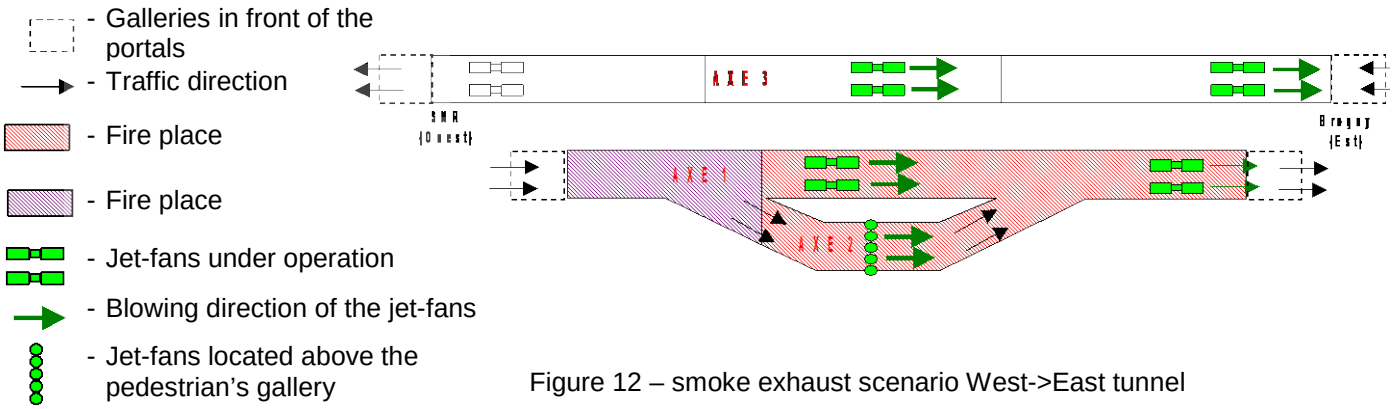


Figure 12 – smoke exhaust scenario West->East tunnel

3.3. TUNNEL CONTROL CENTRES

The tunnels and the car parks are operated by two municipal departments under the same Authority.

The supervision centre for the car parks is located inside the southern car park (**Figure 11, mark 11**). Its mission is the management and the safety of the car park, as well as the surveillance of the toll booths. It is only open during the opening periods for the car parks (18 hours a day).

The supervision centre for the tunnels is located in the building of the City Hall (**Figure 3, mark PC**). Its mission is the technical management and the safety of the tunnels. This centre is operated 24 hours a day. It is also in charge of the supervision of the video surveillance network for the city.

The two supervision centres have direct and permanent links between them (transmission cable and radio communication), which enable coordination in case of an accident or fire and the application of predefined and jointly agreed intervention procedures.

The Fire Brigade is located less than one kilometre from the tunnel. Fire fighters are on site in less than 10 minutes after they have been alerted to the incident. The Fire Brigade has at its disposal inside the tunnel, equipment at the safety niches and those of the firefighting network. The water main is linked with the urban water supply network and assures a flow of 60 m3/h at each fire hydrant.