

## Lighting of short tunnels

The lighting of short tunnels poses problems that are specific to each tunnel, even more so than for long tunnels, with geometry, the approach road, the surrounding environment and the nature and density of traffic all playing a vital role. Each case requires specific study, as visibility can be more problematic in short tunnels than in long tunnels (for example there is no adaptation to the low tunnel luminance when the exit or part of the exit, which is very bright, takes up a large part of the field of view).

For this reason, the decision trees that follow must only be considered as an assessment aid: other factors come into play as mentioned in the paragraph entitled “comments on decision tree use”.

### Definition

When designing lighting, a tunnel is considered to be “short” if there is no interior zone with daytime lighting. Entrance zone lighting can be lower than for a long tunnel with identical approach conditions, or may not even be necessary. This question should be examined when the tunnel length does not exceed the application threshold of the decision trees provided on the following pages, that is to say:

- 125m for an urban tunnel,
- 150m for a bi-directional inter-urban tunnel with heavy traffic or high speeds,
- 200m for a uni-directional inter-urban tunnel with heavy traffic or high speeds,
- 200m for an inter-urban tunnel with low traffic and low speeds.

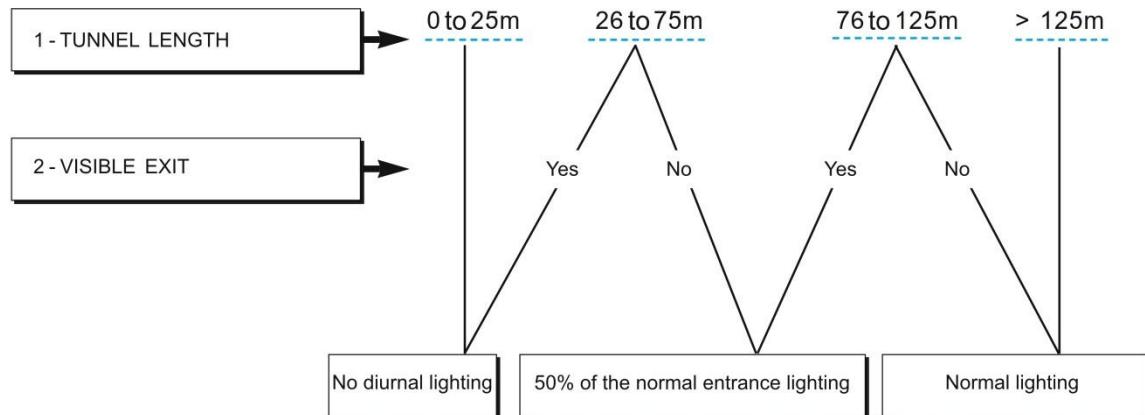
### Urban tunnels

Urban tunnels are characterized by a complex surrounding environment, nocturnal lighting which in most cases provides a continuity with exterior urban lighting, heavy daily rush hour traffic with a risk of congestion and in certain cases, the presence of two-wheelers or pedestrians.

An agreeable environment should be sought through the use of lightly-coloured, light-reflecting sidewalls and a pavement which is preferably also fairly lightly-coloured. When diurnal lighting

is necessary, the luminaires generally provide symmetric lighting and lamps are chosen to provide good colour rendering.

Decision tree n° 1 shows the main elements enabling a decision to be taken as to the necessity and the level of diurnal lighting.



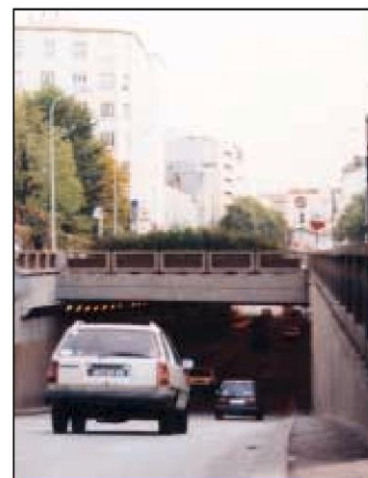
Decision tree n°1 : Urban tunnels

## Comments:

### 1 - Visible exit

This criteria means that the entire exit is visible by a driver located at the stopping distance prior to the tunnel entrance, as shown in the diagram below.

This implies that the access roads, alignment, and longitudinal profile of such a tunnel must not have sharp curves that could block the view of all or part of the outline of the exit.



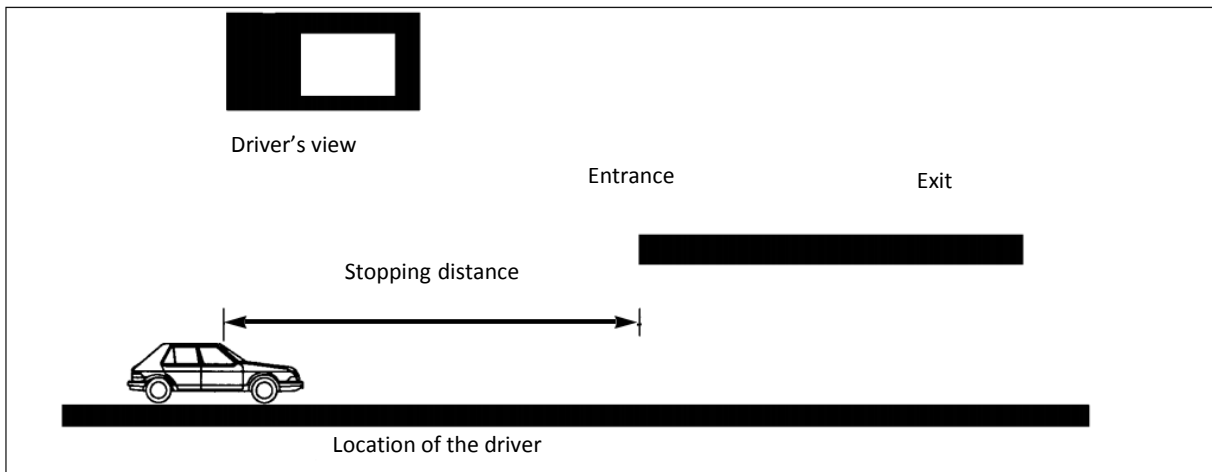
*Brotteaux underpass approach in Lyon  
(the "visible exit" criteria is not respected)*

## 2 – Normal lighting

This installation is designed as for the entrance zone of a long tunnel.

## 3 – Specific case of tunnels with authorized access for pedestrians and / or cyclists

Lighting is installed at a normal level if the tunnel length exceeds 25m, whether the exit is visible or not.



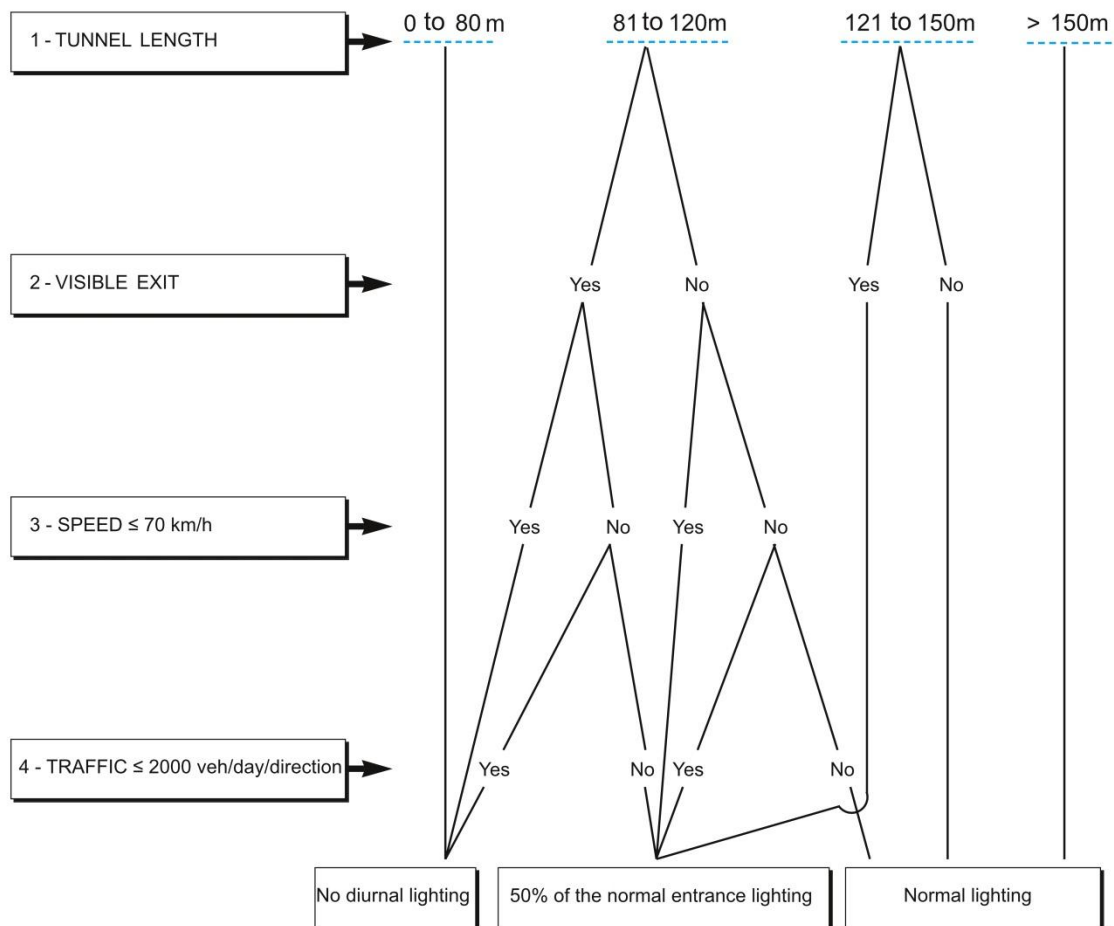
## Inter-urban tunnels with heavy traffic or a high speed limit

The present paragraph concerns inter-urban tunnels where the annual average daily traffic in one direction exceeds 2,000 vehicles, or where the authorized speed is above 70km/h.

This is generally the case for motorway tunnels or roads categorized as “exceptional”, according to French regulations. Traffic is heavy or the speed limit is high, but the view from the tunnel approach is clear and the characteristics of the alignment are good. Pedestrians and cyclists are prohibited.

### *Bi-directional tunnels*

The main elements determining the choice of lighting are presented in decision tree n° 2, where the terms “visible” exit” and “normal lighting” have the same meaning as in the paragraph on urban tunnels.



Decision tree n°2 : Inter-urban tunnels with heavy traffic or a high speed limit - Two-way traffic

### Uni-directional tunnels

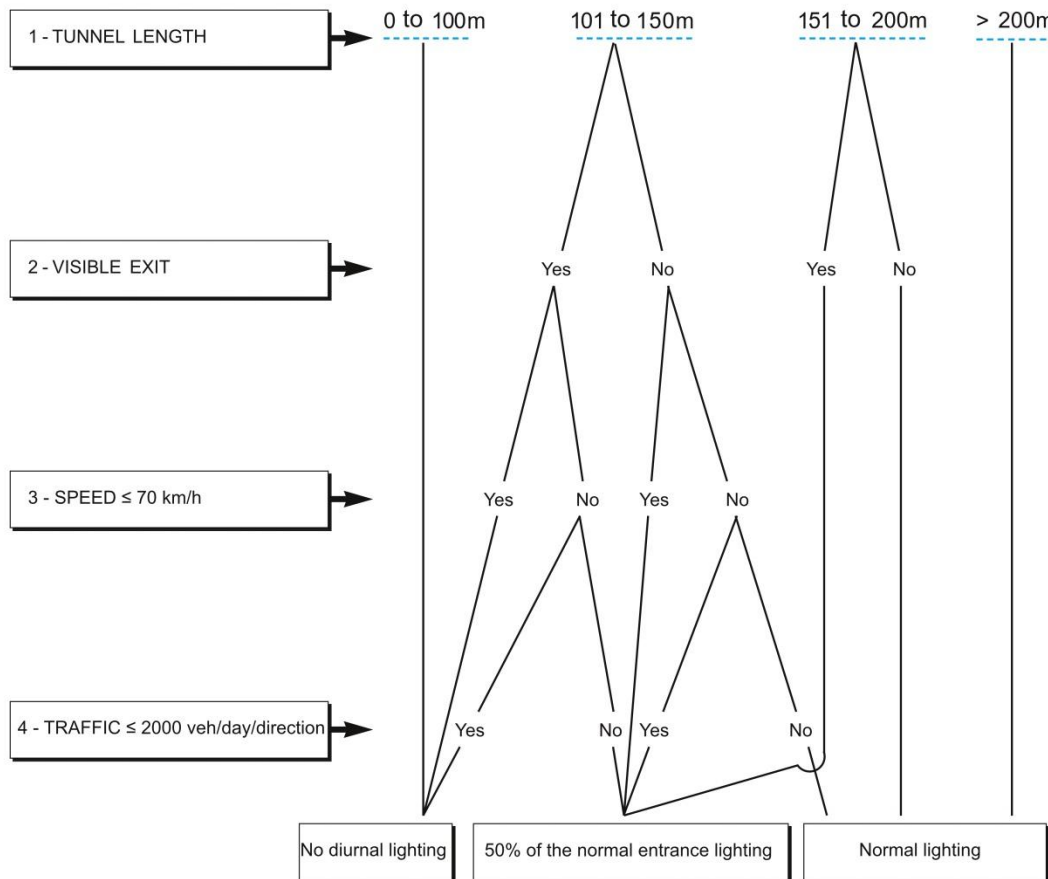
Counter-beam lighting systems are preferable in this type of tunnel. In the daytime, the strong luminance of the exit which is directly visible or visible by reflection onto the sidewalls only enables obstacles to be easily seen in negative contrast (dark silhouette against a light background).

Light-coloured, specular painting of the sidewalls is preferable, to provide the maximum negative contrast to possible obstacles.



Langesse Tunnel on the A8 motorway (the “visible exit” criteria is respected)

The main elements determining the choice of lighting in these tunnels are presented in decision tree n° 3.



Decision tree n°3 : Inter-urban tunnels with heavy traffic or a high speed limit - One-way traffic

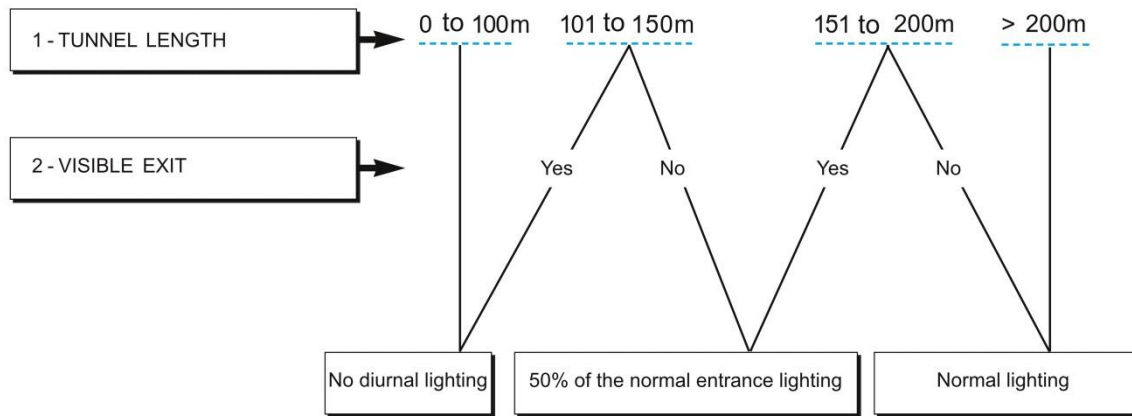
## Inter-urban tunnels with low traffic and a low speed limit

These tunnels have low traffic and the authorized speed is lower than or equal to 70km/h. Generally speaking, they are bi-directional tunnels.

The choice of lighting must take into account the photometric characteristics of their entrances and their surrounding environment, the authorized speed limit and the alignment of the approach road.

One again, a light-coloured coating on the sidewalls is recommended. It must be light-reflecting for symmetrical lighting, which is the best suited to bi-directional traffic at a low speed.

Decision tree n°4 presents the most determinant factors for the choice of lighting.



Decision tree n°4 : Inter-urban tunnels with low traffic and a low speed limit

Whatever the length, it is possible to do without lighting in certain tunnels with low traffic (when the traffic ten years after the tunnel is put into service can be forecast for each direction, when the AADT is lower than 2000 vehicles per day, 400 vehicles during rush hours and the 30<sup>th</sup> heaviest hour in the year. For these criteria, heavy vehicles count for 5 vehicles).

In this case:

- the risk of accidents must be very low and must not be significantly increased by the absence of lighting,
- the costs of lighting , both for initial investment and operation, must outweigh the benefits in terms of safety and comfort.

If the decision is taken not to install lighting, and if the length of the tunnel is greater than the length at which the present document recommends diurnal lighting, then suitable signs must be positioned at each entrance of the tunnel. These signs must warn drivers of the absence of tunnel lighting, ask them to switch on their headlights and impose a speed limit adapted to the environment of the access road and the tunnel, which in principle should not exceed 50km/h. In addition, marker lights should be installed on the lower part of the sidewalls.

## Comments on decision tree use

The factors listed in the previous decision trees are not the only ones to be taken into account. They provide indications on an initial approach in terms of lighting but do dispense with the need

for an analysis of the traffic and the geometry of the accesses to the tunnel, both in terms of horizontal alignment and longitudinal profile, which should facilitate road legibility.

These decision trees are designed for tunnels which are prohibited to dangerous goods transport. If this is not the case, a specific study must be conducted and may lead to the choice of stricter criteria.

In all cases, lighting must be designed without taking into account the photometric characteristics of the sidewalls. However, if they are not lined, are very dirty or and have very little light-reflecting properties, the “non-visible exit” criteria may be chosen.

Certain factors are not mentioned, as they are more complex, notably when the longitudinal profile is problematic and there is a significant proportion of heavy vehicles. In certain awkward cases, which may lead to uncertainties, the choice which will provide the best legibility is recommended.

## **Guidance equipment**

For tunnels that do not have normal lighting, guidance equipment is of major importance and requires particular attention (choice, installation, maintenance and cleaning of equipment). This equipment may be located:

- on the pavement (retro-reflective road markings)
- on the sidewalls:
  - retro-reflective studs (delineators, route guidance)
  - retro-reflective strips or films
  - electroluminescent diodes
  - marker lights
  - etc.

## **Nocturnal lighting**

For tunnels equipped with diurnal lighting, it is recommended to enable a lower lighting level, in the same conditions and with the same exceptions as for long tunnels. In other tunnels (especially urban or motorway tunnels), it is advisable to provide nocturnal lighting or simple guidance equipment/ markings that will highlight their specific nature on the given route.