

Urban insertion of surface public transport

Trams and visibility: existing issues and rules

The series
of factsheets
"Urban insertion
of surface public
transport" deals
with questions
of planning,
roads and signage
related to the
interface between
transport systems
and other uses
of public space.

Visibility is an issue as part of the process of obtaining and processing information. Poor visibility may hamper the smooth running of the process and therefore constitute a collision risk factor between a tram and a third party, and even between third parties. Minimizing or eliminating this risk factor will help decrease the frequency and severity of such collisions.

The following document is intended for contracting authorities, urban planning practitioners (prime contractors, road and green space managers, designers, architects, urban planners, landscape designers, etc.), as well tram line operators.

After reviewing the issues, the document aims firstly to identify, in the most comprehensive manner possible, visibility problems related to the presence of masks on public property or on private property, and secondly, to propose tools for the prevention and treatment of the masks encountered.

The following issues are discussed:

- mutual visibility between trams and third parties (pedestrians, cyclists, motor vehicles);
- visibility of signals by tram drivers and other road users;
- mutual visibility between third parties (related to the presence of trams and their equipment).

The issues identified in this factsheet and the recommendations made can also be applied to Bus with a High Level of Service (BHLS) networks designed and operated like tramways.

IUTCS

September 2015

Succeeds the publishings of

Certu

Understanding the visibility needs of each user

One definition of visibility is the physical possibility for users to see each other or, for a given user, to see a situation, signage, an obstacle, etc.

This notion of visibility is inseparable from the speed of trams and other road users.

This speed affects the user's visual field, as well as reaction and braking times, and therefore safety.

From the point of view of the driver

Driving on sight is the basic principle applied by the driver of a tram: he adapts his speed and determines how he drives by what he sees. The kinematics of a tram (braking and trajectory) are specific and must be taken into account: the stopping distance is greater than for buses, and it is impossible to "swerve" to avoid hitting a third party.

So it is essential for tram drivers to have a sufficiently long visibility distance at any point on the line in order to anticipate any unexpected event on the tram tracks, to react and adjust driving accordingly, without having to resort to emergency braking. Any emergency manoeuvre impacts both the safety of passengers, possibly causing them to fall, and the availability of the transport system (commercial speed and damage to rolling stock). It should therefore remain exceptional.



Tram braking distances

The minimum performance requirements for tram braking systems are defined by standard NF EN 13452-1.

The stopping distance of a tram depends on its speed, the situation, the response time and deceleration γ .

*Example for a rail-based tramway
with a man-machine reaction time of 1.5s*

Speed of the tram	15 km/h	30 km/h	40 km/h	50 km/h
Stopping distance with NSB* (in m), with $\gamma = 1.2 \text{ m/s}^2$	14 m	42 m	69 m	102 m
Stopping distance with EB* (in m), with $\gamma = 2.8 \text{ m/s}^2$	10 m	25 m	39 m	55 m

(*) NSB = Normal Service Brake

(**) EB = Emergency Brake

From the standpoint of other users

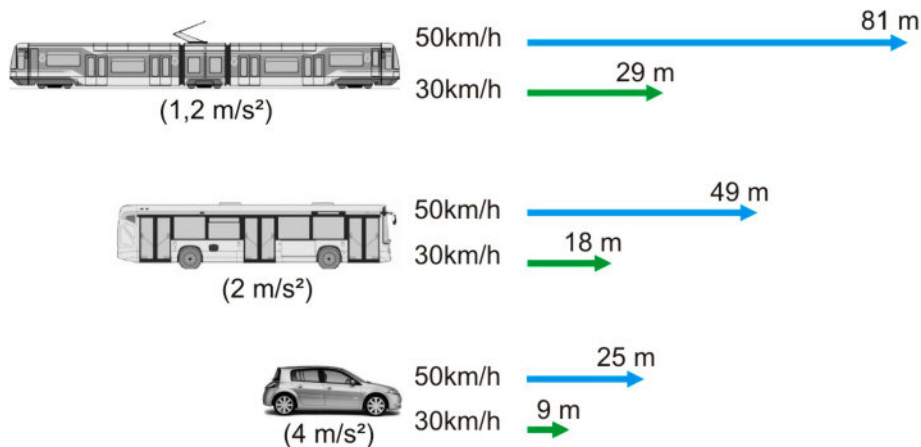
There are many categories of users travelling near a tram tracks or crossing it: pedestrians, bicycles, motor vehicles, etc.

They should have good visibility upstream of the tram tracks crossings, both of signals interfacing with the tram line (vertical markings and light signals), of trams running on this tram tracks, and of other third parties.

Any thinking about the treatment of mutual visibility between trams and pedestrians must consider the requirements for these users, particularly the stricter ones relating to children, the elderly and other persons with reduced mobility.

Braking distances

Approximate braking distances under normal conditions (service braking for trams, comfort braking for buses, because of standing passengers); to estimate stopping distances, distances travelled during machine and driver reaction time must be added.



Distinguish different types of masks and related risks

Risks related to masks are located:

- in road intersections (including cycling facility crossings) and approaches to these;
- in line with and approaching pedestrian crossings (isolated, at intersections or at stations), which can also be used by bicycles;
- in links (between junctions), where impromptu events may occur.

⇒ lack of mutual visibility between pedestrians and trams approaching an organized pedestrian crossing;



Pedestrians masked by tall plants

Masks related to plants

Plants, whether pre-existing or planted for landscaping reasons, are an integral part of the tram environment.

Plants, whether on public space or on a resident's property, can hamper visibility:

• Visibility between trams and third parties

⇒ line of plants creating a wall effect;



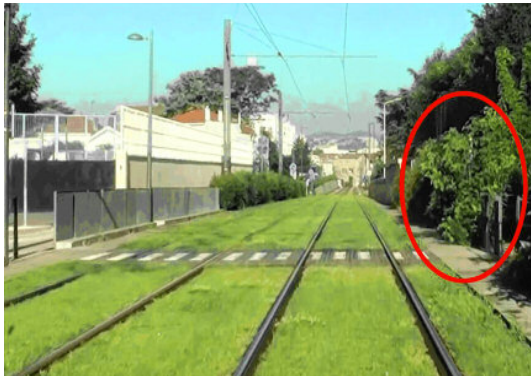
Alignment of plants affecting the tram driver's visibility of any unauthorised crossing of the tram tracks by pedestrians

⇒ lack of mutual visibility between trams and vehicles or cyclists approaching an intersection;



Landscaping of the central island completely obscuring the dedicated site of the BRT passing through it

✧ plants "overflowing" from a resident property and masking visibility of an intersection;



Unmaintained resident hedge that may hide a pedestrian intending to cross

✧ plants "overflowing" from a resident property and masking signals.



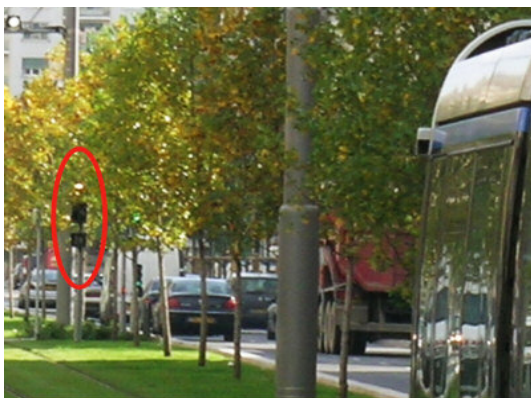
Mask detected during work to build the tram tracks: resident hedge obscuring the traffic light

• **Signal visibility**

The terms "signals" and "signage" include road and rail signalling, advanced (or pre-signalling) and position, static and light.

Signals can be positioned at the edge of, or above the tracks:

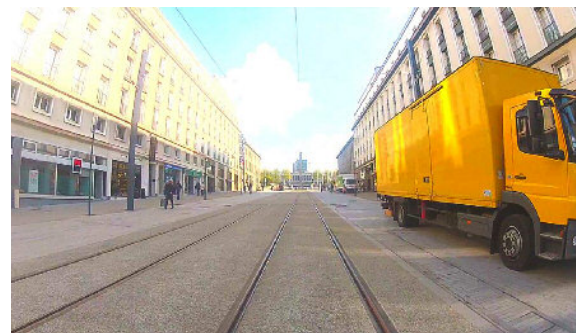
✧ landscaping (trunks or foliage) masking road and rail signals;



R17 signal obscured by foliage

Masks related to parking

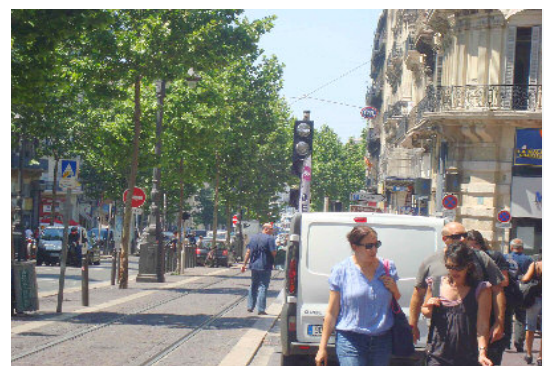
A vehicle, even a light one, parked legally or illegally, or a bus at a stop near the tram tracks, etc., may obscure visibility:



Delivery vehicle near the Minimum Clearance Outline (MCO) masking other users and resident access

• **Visibility between trams and third parties**

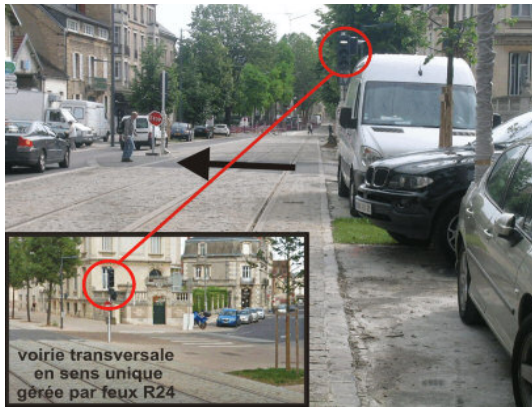
✧ lack of visibility of pedestrians approaching a pedestrian crossing;



Illegal parking affecting visibility of pedestrians

Maintaining plants can be complicated near an overhead power line: it may require not only the power to be cut off but also pruning work to be carried out at a time compatible with both with tram operating schedules and the provisions of road regulations.

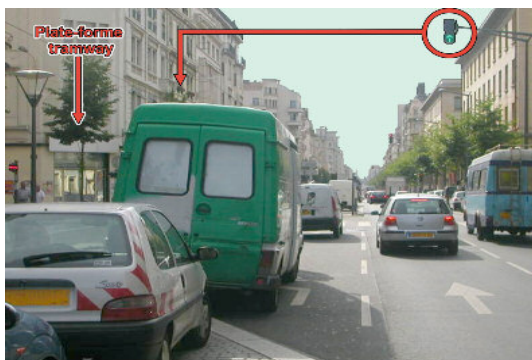
- ↪ lack of mutual visibility between trams and vehicles or cyclists approaching an intersection;



Difficult for the tram driver to see what traffic is on the adjacent road

• Signal visibility

- ↪ lack of visibility of road and rail signals;



The left-turn directional traffic light (different from the straight-on light on the overhead post) is masked by the van parked on the road lane for a user who has to cross the tram tracks

Masks related to furniture

The term "furniture" here covers advertising hoardings and lighting structures, fences and barriers, kiosks, bus shelters, vertical signalling equipment, civil engineering structures, etc.



The artwork on the roundabout compromises visibility between trams and other vehicles

This furniture, whether installed permanently or temporarily, such as during sports or cultural events, may obscure visibility:

• Visibility between trams and third parties

- ↪ furniture masking pedestrians;



Bar or restaurant terrace windbreak that may hide a pedestrian wanting to cross the tram tracks

- ↪ furniture masking visibility for other road users;



Tram driver's visibility hindered by the advertising hoarding



Advertising "lollipop" and kiosk hiding pedestrians about to cross the tram tracks

- ⇒ fences and barriers creating opaque walls that may hide pedestrians;



Poor visibility of the break in the barrier and therefore of any pedestrians likely to cross the tram tracks

NB: French departmental health regulations require sites opening onto public roads or on the edge of these to be surrounded by a fence to prevent people from entering.

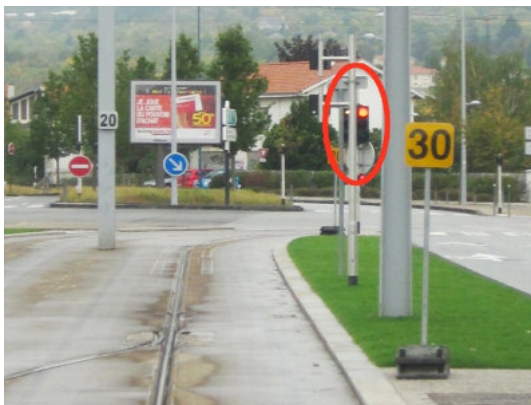
- ⇒ parked construction vehicles hindering visibility.



Construction vehicles masking visibility at the approach to an intersection

• Signal visibility

- ⇒ various structures obscuring signals.



Structure upstream of the R17 signal making it less visible

Masks related to the built environment

The notion of built environment is here extended to ancillary equipment such as canopies, awnings, signs, etc.

• Visibility between trams and third parties

- ⇒ building (wall or block of flats) obscuring visibility of the intersection. This situation can occur in bends where the track is close to buildings, despite the fact that speed is reduced by the route;



Building angle preventing the tram driver from seeing pedestrians waiting to cross

Masks related to construction work

Construction sites, whether in public or private areas, may hinder visibility between trams and third parties, and visibility of signals.

- ⇒ hindrance due to construction site fencing;



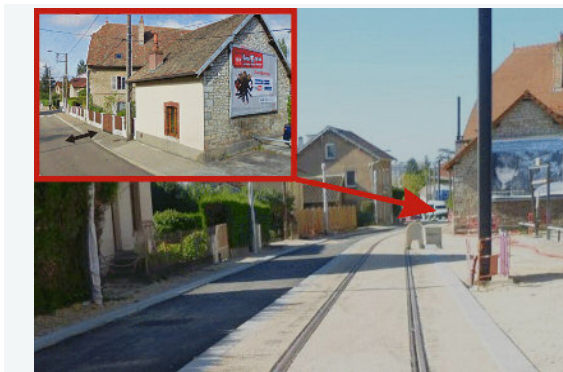
Protection de chantier masquant les autres usagers et la signalisation

- ⇒ resident fencing obscuring visibility of the intersection;



The wall close to the tram tracks and the road makes it impossible to see whether a vehicle is stopped behind the R24 signal and mobile barrier

- ⇒ insufficient visibility of resident access;



Access to the building in the bend (on the right in the photo) not clearly visible from the tram tracks. Visibility is also a problem for residents leaving their home

• **Signal visibility**

- ⇒ building (wall or block of flats) obscuring visibility of signals;



Retaining wall masking signalling in the bend

Masks related to the tramway and its equipments

Tram system equipment includes overhead power line structures, signalling cabinets and station furniture. These may hinder visibility:

• **Visibility between trams and third parties**

- ⇒ equipment masking pedestrians or road users;



Pedestrian crossing obscured by the electrical cabinet

- ⇒ station furniture masking pedestrians;



Ticket distributor masking station users

• **Signal visibility**

- ⇒ overhead power line structures masking train and bus signs;



If it were not duplicated, the R17 signal would be obscured by the overhead power line post

- **Visibility between third parties**

- ⇒ tram at the station obscuring visibility of the intersection;



Station furniture masking visibility for left-turning vehicles

- ⇒ night time visibility on pedestrian crossings;



In the absence of special lighting of the tram tracks, visibility on pedestrian crossings is sometimes insufficient

- ⇒ glare from vehicles travelling on parallel roads;



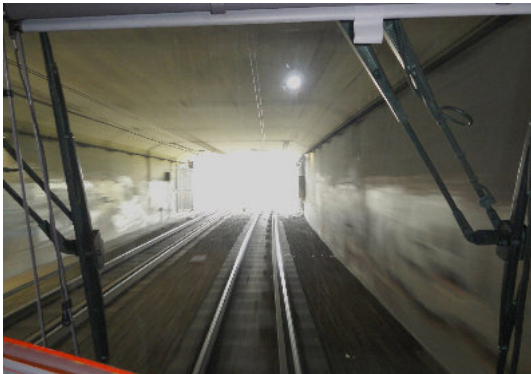
The position of the tram tracks parallel to the road can cause reciprocal glare problems due to the lack of residual or urban lighting.

It can also create a surprise effect for road vehicles that are not expecting to see a vehicle travelling in the opposite direction on their right.

Visibility problems related to lighting

- **Visibility between trams and third parties**

- ⇒ impaired visibility inside and when leaving civil engineering structures (underpasses and tunnels);



Glare when leaving a tunnel

Using tools

From the standpoint of regulations

... pertaining to urban planning:

- ⇒ Mayors will ensure application of the regulations on signage, accessibility and use of public property. For the latter, they will reinforce inspections by the relevant police authorities as required.

In terms of signalling, the principles of enhancement, concentration and clarity must be respected.



Over-abundant signage masks the traffic lights for road users

The various texts on the accessibility of roads for people with disabilities and the various standards related to street furniture do not incorporate the issue of visibility.

Lighting management is organised regardless of the presence of the tramway. There is no regulatory obligation to light public spaces and roads. However, a number of standards govern the design and maintenance of facilities.

- ⇒ Modification of planning documents (local urban development plans) during a tramway project is an opportunity to both define the imperatives inherent in proper operation of the tram network and to manage certain causes of visibility problems such as furniture, plants, etc.

Urban planning regulations

Articles L114-1 to 6 of the French road design and administration rules lay down the instructions for easements to ensure better visibility.

Article R111-5 of the Urban Planning Code determines the acceptability of a project by assessing the impact on the safety of public road users.

Construction sites

The installation of fencing or hoardings on public property is subject to prior authorization from the municipality, as is the creation of accesses, even temporary ones, to the site.

In addition, Decree No. 2011-1241 concerning the execution of works near certain underground, overhead or underwater structures for transport or distribution sets the rules for reporting prior to the work applicable to the contracting authority (projected work declaration) and to the company performing the work (declaration of intent to begin work).

It governs work techniques in the immediate vicinity of networks and provides for the obligation to obtain authorization for work close to networks for certain workers before work begins and while it is in progress.

In cases where the site is located on private property, there must be a statement of work or a building permit.



A building near the minimum clearance outline requires consultation

... pertaining to the guided transport system:

A tram project is part of the public space, itself subject to regulatory imperatives:

- Decree No 2003-425 of 9 May 2003 on the safety of guided public transport defines the process for assessing design safety, the building and running of guided public transport systems, throughout their service life;
- The guides for applying the content of the safety documents mention the problem of visual masks.

Design and building

Safety design assessment lies primarily with the prime contractor.

Accredited experts or qualified bodies, chosen by the transport authority, are responsible for assessing compliance of the tram project with regulations, standards and technical specifications in force.

They also have a mission to assess whether the level of safety required for the system as a whole, as well as the ability to maintain this level over time, have been attained.

Operation

The transport authority ensures that throughout the operating life of the system the state of infrastructure and equipment it provides for the operator is adequate to achieve the required safety objective.

It also ensures that the operator complies with the Operating Safety Regulations, approved by the prefecture. These regulations provide for permanent monitoring and evaluation of the system's safety.

State control

The prefect of a department in which the transport system is located may at any time inspect the operator to verify compliance with the provisions for achieving the required level of safety.

He may ask the transport authority and the operator to remedy any defect or failing of the transport system or the way it is operated.

In an emergency, the Prefect may order the service to be stopped without prior notice.

The prefect will authorize resumption of operation as soon as safety conditions have been restored.

- the choice of plant species, how they are planted near the tramway tracks, and how they are maintained;
- defining the monitoring arrangements for visibility problems over time (by means of a convention, for example).

Care must be taken in selecting and planting plant species, seeking to reconcile the objectives of visibility and road safety, and the following parameters:

- imperatives related to the town (available land, clearance above the tracks, road safety, different types of attack, park management conditions);
- characteristics of each plant species (shapes, growth cycles, climate and soil requirements, susceptibility to parasites)..

From an organisational standpoint:

The "visibility" topic can be dealt with during an extended consultation with all local stakeholders (urban transport authorities, tramway network operators, municipal staff, local authority engineering departments, road and green space managers, network concession-holders, etc.):



... while the tram network is being operated

Consultation may take various forms depending on the local context: regular monitoring committees, conventions, etc.

The aims are:

- upkeep of green spaces;
- examining permit applications to build near the tram tracks;
- joint definition of instructions with the site organizers (access and parking);
- changes to road layouts (removing parking spaces that may act as a mask, etc.);
- urban furniture;
- defining response times;
- making people in charge of these issues aware.

... during the tram project phase

Consultation with residents and shopkeepers, helps to minimize problems related to the built environment

Associating with a tram operator is essential to take advantage of his experience.

Partnership work with all stakeholders may include:

- setting up visibility easements;
- the choice of furniture, how it is installed and maintained (e.g. maintenance of lighting located near overhead power lines may require power to the line to be shut off);

To do this, a procedure involving the transport authority, the operator and the road manager may be implemented in certain critical areas defined by the operator beforehand to allow curative work to take place when the operator reports the need to do so, for example.

The transport authority, the transport system operators, and managers of roads and green spaces can:

- establish periodical inspections to detect any changes in the vicinity of the tram tracks that may mask visibility and schedule preventive maintenance;
- take into account information reported by drivers (curative maintenance);
- listen to what users and residents in the public space have to say;
- take into account changing uses and flows in the vicinity of lines (e.g. new pedestrian crossings).

From a technical standpoint (in the project or operating phases)

In places where the tram driver's visibility of pedestrians is reduced, the following can be done:

- deter unauthorized crossings of the tram tracks, for example by reinforcing hedges with a fence;
- set up fences and barriers to organize the pedestrian route, without creating any additional masks..



Barriers encourage pedestrians to cross the tram tracks well downstream of the kiosk

To improve visibility at approaches to intersections and pedestrian crossings, the following should be done:

- maintain or remove plants that act as screens;
- move tram equipment and street furniture, preferably during the initial phases of the project;

- remove awkward parking spaces or turn them into parking spaces for two-wheelers;
- deter unauthorized parking by development work and / or controlling it.

Screens can solve problems with glare from vehicles travelling on parallel roads.



Anti-glare device between tram tracks and road

Inability to remove a mask may make it necessary to install appropriate signalling.



Exits from resident premises can be managed by traffic lights.

In the absence of solutions, the principle of driving on sight will lead to a reduction in the speed of the tram.

Design and layout
Antoine Jardot
DADT - VIA
Cerema
Direction territoriale
Normandie Centre
+33 (0)2 35 68 89 33

photos :
Cerema,
ERA,
Keolis-Lille,
Keolis-Lyon,
Ville de Paris,
RTM,
SEMÉTAN,
STRMTG,
T2C,
Transamo.

Trad.:
Birdwell Institute

*Warning on the translation:
The purpose of translated
documents and publications
is to pass on to non-French
speaking readers the
French know-how set out in
the original publication,
whether this concerns
methodologies, tools or
best practices. Original
publications in French are
subject to a checking
process, which leads to a
Cerema commitment
regarding their content.
English versions do not
undergo the same process,
and consequently carry no
Cerema commitment. In the
event of differences
between the English and
the original French text, the
French text serves as the
reference*

*French sheet edited in
December, 2014.*

2015/41

© 2015 - Cerema
*This document may not
be reproduced
in part or in full,
without the prior
consent of Cerema*

Bibliographical references

Regulations

- Code de la voirie routière (French road design and administration rules)
- Code de l'urbanisme (Urban planning code)
- French law no. 2005-102 of 11 February 2005 for equal rights and opportunities, involvement and citizenship of people with disabilities,

and its official texts

- Decree No. 2011-1241 concerning the execution of works near certain underground, overhead or underwater structures for transport or distribution
- Decree No 2003-425 of 9 May 2003 on the safety of guided public transport
- France's official guide to road signs and markings (Instruction interministérielle sur la signalisation routière)
- Standards for lighting:
 - NFC 17200 - Electrocution hazard
 - NF EN 40 - Stability of columns
 - NF EN 13201 - Photometric performance
- NF EN 13452-1 – Railway applications - Braking systems for urban and suburban public transport

Other documents

- *La visibilité, Road Safety Fundamentals factsheet*, CERTU, December 2008
- *Guide d'implantation des obstacles fixes à proximité des intersections tramways / voies routières*, STRMTG, 2007
- *Sécurité routière : ce que peuvent faire les maires – Lutte contre les risques routiers en milieu rural et urbain*, La Documentation Française, 2006
- *Les plantations d'arbres en ville – Le long des rues et sur les places*, CERTU, April 2002

Author Céline Debes Magnino - Cerema - Direction territoriale Centre Est
Tél. : +33 (0)4 74 27 51 21 - celine.debes@cerema.fr

This factsheet was prepared by a working group composed of: Laurent AIT Aoudia (RTM), Dominique Bertrand (Cerema), Marine Blancheton (STRMTG), Christian De Waroquier (Keolis), Céline Debès (Cerema), Justin Ledoux (City of Paris), Sébastien Lopez (Transamo), Denis Marcellin (ERA), Carine Paglia (T2C), Yvon Primel (Keolis-Lille), Alain Quéré (Keolis-Lyon) and Stéphane Riou (Semitan).

Contacts Dominique Bertrand - Cerema - Direction technique Territoires et ville - VOI/CGR
Tél. : +33 (0)4 74 74 58 48 - dominique.bertrand@cerema.fr
Marine Blancheton - STRMTG - Division Tramways
Tél. : +33 (0)4 76 63 78 65 - marine.blancheton@developpement-durable.gouv.fr
Secrétariat - Cerema - Direction technique Territoires et ville - VOI
Tél. : +33 (0)4 72 74 59 61 - voi.DtecTV@cerema.fr

The series of factsheets "Urban insertion of surface public transport" is produced under the guidance of the Cerema Technical Division for Territorial Development and Urban Planning.
Neither the Administration nor the authors may be held liable as a result of this document.
These sheets are available from the online store of the Technical Division for Territorial Development and Urban Planning: www.cerema.fr section Our publications (Nos éditions).

Risk knowledge and prevention - Infrastructure development - Energy and climate - Infrastructure and asset management Health impacts
Mobility and transport - Sustainable territories and natural resources - Sustainable cities and buildings