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STRMTG

Urban insertion of surface public transport

Tramways in general traffic

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

IUTCS

This factsheet concerns sections of lines in general traffic areas, where trams and general traffic share the same carriageway.

There are few such sites in France. Tramways disappeared during the twentieth century to make way for private cars. In the 1980s, the development of new "French-style" tramway lines essentially featured infrastructure in dedicated lanes and redevelopment from one side of the street to the other. For some of our European neighbours, trams have never disappeared, and tramway infrastructure has naturally been divided between guided transport and general traffic. This explains the number of general traffic areas encountered particularly in Switzerland or Germany.

This document is based on a general study carried out in 2014 and an analysis of ten or so existing sites in France. Its purpose is to explain the issues relating to the development of general traffic areas, provide feedback on how they work, define where they are appropriate, and make recommendations for the development and running of these areas.

Factsheet no. 03 – September 2018

1. General traffic areas in France

1.1 Definition of general traffic areas

A "general traffic area" is a section of a line where trams run within general traffic (even when the latter is for residents only). From a legal standpoint this site is accessible to all categories of vehicle.

This definition does not include pedestrian areas through which trams pass because, in principle, they are not open to general traffic, or shared tram areas which are open only to certain categories of vehicle such as buses.

1.2 Inventory of sites

Of the 25 tram networks in service in 2013, 15 networks had general traffic areas, and 5 networks were planning to create new general traffic areas[1].

65 sites were identified in France:
- 48 on lines in service;
- 17 on projected lines (or extensions of lines).

In total, sections in general traffic areas represent about 13 kilometres, or about 2% of the total length of networks existing at that date.

1.3 Characteristics of the sites

The general traffic areas identified in France in 2013 are mainly in areas where space is at a premium and are located in various contexts. In general, they are to be found in dense urban areas or residential areas with little car traffic, and are generally less than 500 meters in length.

Concerning traffic levels on the 48 general traffic areas in service, only 8 sites have over 5,000 vehicles/day (counting both directions).

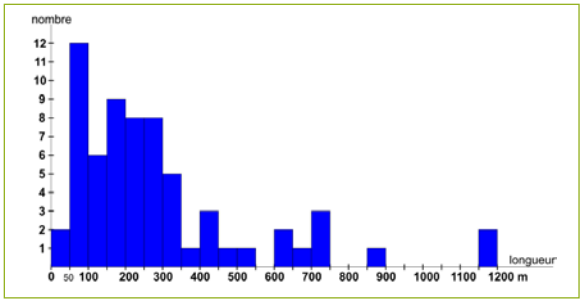

Illustration 1: Length of general traffic areas in France referenced in 2013

The general traffic areas that have been developed also have varied cross-sections:
- 40% of the sections have 1 lane in a general traffic area + 1 dedicated lane;

- 35% of the sections have 2 lanes in general traffic areas;

- 20 % of the sections have 1 lane in a general traffic area + 1 dedicated lane + 1 road lane;

The remaining 5% correspond to special developments, with atypical layouts, such as one lane in a general traffic area and one lane shared with buses.

The majority of sites (about 60%) therefore have only one lane in a general traffic area.

1 Trams operating in general traffic areas, phase 1 (Study Report, Cerema, 2014).

2. Analysis of the operation of the sites and experience feedback

Feedback is based on the analysis of some twenty general traffic areas spread over eight networks: Angers, Bordeaux, Le Mans, Montpellier, Nantes, Reims, Saint-Étienne and Toulouse. Interviews were conducted with the transport authorities, road managers and operators[2].

2.1 Tramway accident rates

At the national level, the percentage of accidents occurring in general traffic areas is estimated overall at 2% of the total. General traffic areas have an accident rate per kilometre comparable to that observed on all networks nationally[3].

Analysis of accident data over the period 2004-2013 makes it possible to identify the specific features of accidents occurring in general traffic areas.

Of the accidents recorded in general traffic areas (460 events), collisions with a third-party account for 81% of events, and passenger events 16%. By way of comparison, the typology of events at national level, outside general traffic areas, has 68% of collisions with a third-party and 26% of passenger events. The proportion of collisions with a third-party is therefore higher in general traffic areas.

The distribution of third-parties involved in collisions is also different. Heavy goods vehicles and commercial vehicles are more involved in collisions on sections in general traffic areas than in those occurring on all lines. Conversely, there are fewer collisions with pedestrians and cyclists.

In general traffic areas, 13% of these collisions with third-parties result in casualties (either injured or killed), compared to 24% for all lines. The severity of collisions between trams and light vehicles is lower in general traffic areas.

It can be assumed that the low severity of accidents is related to the lower speeds of vehicles and trams in general traffic areas. This limited speed could also result in less emergency braking, and therefore fewer passenger accidents, which would explain the higher percentage of third-party collisions.

2.2 Impact on tramway level of service

A tram line is run on the principle of driving on line-of-sight[4]. In a general traffic area, trams are blended into the traffic with other users, and so drivers must be particularly vigilant. To limit the risk of collisions or accidents, some networks require trams to run at a maximum speed of 30 km/h in general traffic areas and/or respect safety distances of 30 to 50 m from road vehicles in front of them.

Because of the priority given to trams as they enter a general traffic area by means of traffic signals, trams have a free space in front of them. If motor vehicle traffic is free-flowing in the section, the tram will be able to move into the area without being slowed down by other vehicles.

In the absence of congestion, feedback from experience shows that setting up a general traffic area of limited length has no real impact on the performance of the tram network. This is because even though commercial speed is reduced in these sections, the short length of general traffic areas in France means that the time lost remains negligible. The time lost can, however, be amplified by vehicles waiting on the roadway structure to turn left into a street or residential access (or turn right in countries which drive on the left).

2 *Circulation des tramways en site banal, l'exemple de Saint-Étienne, Reims, Angers, Le Mans et Nantes* (Trams running in general traffic areas: the example of Saint-Étienne, Reims, Angers, Le Mans and Nantes)(study reports, Cerema, 2015).
3 Source: Tram event database (STRMTG).
4 Driving on line-of-sight involves tram drivers adapting their speed and driving pace to their environment. They must be able to stop at any moment when they see an obstacle already present on their trajectory.

2.3 Motor vehicle traffic

In order to facilitate the progress of trams in general traffic, the authorized speed for trams is generally the same as that of other traffic . Making the speeds of the various vehicles homogeneous in this way makes it possible to limit the risk of car drivers overtaking trams.

At stations, however, such behaviour may be observed. Stations can be designed with a central island platform to dissuade car drivers from overtaking.

Illustration 2: Station with island platform in Reims

On the other hand, when platforms are positioned laterally, the presence of axial separators helps to reduce the opportunities for overtaking . The majority of road managers have chosen to install separators that cannot be passed over by motor vehicles such as kerbs, bollards, or half-spheres.

Illustration 3: Separators upstream of a staggered platform station in Montpellier

At stations, the layout of the platforms means that the lane narrows, leading to a risk of collision between road vehicles and the platform nose. To avoid these impacts, some networks have bevelled platform noses or use extra marking (J4 signs, reflectors, etc.).

Illustration 4:
Cutaway in Bordeaux

In linking sections, some networks have chosen to arrange a separator between a general traffic area and another lane (a road, a general traffic area or dedicated site). This separator may or may not be traversable. Although separators are considered useful near stations, their usefulness in linking sections depends mainly on the context of the street (traffic, speeds, life in the neighbourhood, etc.).

2.4 Pedestrians

In the case of a general traffic area, trams adapt to the general context, but they have priority over pedestrians.

To mark this difference in the priority system, some networks such as Angers, Toulouse or Bordeaux have chosen not to have regulation pedestrian crossings, but to suggest them by marking them differently, using studs for example.

Illustration 5: Recommended pedestrian crossing in Bordeaux

In Saint-Étienne, pedestrian crossings were marked statutorily in general traffic areas, but then for reasons of user understanding, the white stripes were erased and replaced by dashes or studs flanking the crossing.

In Angers, information boards were temporarily fitted on suggested crossings when first put into service, to remind pedestrians of this tram priority rule.

Illustration 6: Temporary information board on a crossing in Angers

Some road managers have chosen to manage pedestrian crossings by fitting R12 lights, mainly at intersections. The official marking for pedestrian crossings is applied and the pedestrian light systematically turns red when a tram arrives. This clarifies the priority system between trams, pedestrians and car drivers.

In general traffic areas with separators, when people cross outside the crossing areas, pedestrians were regularly observed to trip or fall when the separators were low and insufficiently contrasted. In Angers, managers had to put reflective strips on these separators to make them more visible.


Illustration 7: Separator between a general traffic area and a dedicated corridor in Angers

2.5 Taking account of cyclists' and motor-cyclists' needs

In general traffic areas, the presence of rails in the roadway may lead to accidents for cyclists and motor-cyclists, if wheels get stuck in them. Rail slip problems can also cause falls.

In Angers, special ground markings were placed at the end of general traffic areas to warn cyclists and motor-cyclists about the danger ahead due to crossing the rails at an angle.

Illustration 8: Ground marking at the exit from a general traffic area in Angers

To enable them to move safely, two strategies were observed. When there is enough room, the first solution is to provide cyclists with a safe path outside the general traffic area by creating a cycle path or a greenway.

Illustration 9: Cycle path in Montpellier

If cyclists are forced to travel in the general traffic area, the second solution is to secure the site as much as possible. This is what happened in Bordeaux, for example, where an extra width for bikes was added outside the tramway swept path.

Illustration 10: An extra width for bikes on rue d'Argonne in Bordeaux

Stations with side platforms may lead to a break in the continuity of cycle routes, unlike stations with island platforms.

On some networks, two-wheelers (powered or otherwise) have been seen overtaking on platforms when trams stop in stations. To cope with this problem, in Nantes barriers have been set up upstream of the stations to restrict access by two-wheelers.

Illustration 11: Barriers at the entrance to the station to deter two-wheelers (powered or otherwise) in Nantes

2.6 How the beginning and end of general traffic areas operates

Tram entry to all the general traffic areas studied is managed by light signals (R11v or R24 lights for general traffic, R17 lights for trams), whether this entry is at an existing junction or requires a special intersection.

Management of the start of general traffic area by means of traffic lights makes it possible to give priority to trams and to secure their entry to the general traffic area.

Illustration 12: Entrance to a general traffic area in Brest managed by R11v lights

Illustration 13: Entrance to a general traffic area managed by R24 lights in Toulouse

At the end of a general traffic area there is a divergence of two streams of traffic. Generally, it is the roadway that diverts away from the tramway, particularly because of the more constrained radii of curvature on a tramway than on a road.


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Illustration 14: End of mixed traffic area deviating from general traffic in Reims

If the end of a general traffic area coincides with a bend in the tramway, the trackbed may also be deviated.

Illustration 15: Exit from a general traffic area with a bend in the tramway in Toulouse

The exit from a general traffic area may also be made at a light-controlled junction. In the majority of cases, to prevent tailbacks from obstructing the progress of the tram, the general traffic area is interrupted upstream of the junction.

Whatever the layout of the exit, car drivers have occasionally continued their course onto the dedicated corridor.

To minimize this risk, road managers are seeking to improve the clarity of development work by using different surface coverings (particularly non-traversable surface coverings for the tramway trackbed), by grassing dedicated corridors, or by reinforcing existing signage. Exits can be indicated by road signs (one-way signs - except for trams - or B27b signs) and by means of road markings.

In Angers, for example, a sign has been created to guide car drivers as to what path to take.

Illustration 16: Sign in Angers at the exit from a general traffic area

2.7 Operation of intersections and residential access

Priority is given to the tramway at all intersections. Intersections located inside general traffic areas are generally managed by stop signs. Some crossroads initially managed by give-way signs have been modified with stop signs for safety reasons. General traffic areas often occur on roads with a small width. They are therefore often placed near buildings, leading to visibility problems. This lack of visibility can be made worse by nearby parking. Reduced visibility may lead to car drivers moving forward, going past the stop sign and entering the tramway swept path..

Illustration 17: Vehicle having gone beyond the stop line into the tramway swept path in Le Mans

Some intersections are also equipped with traffic lights (R17 for trams and R11 for car drivers). In general traffic areas, both lights can be arranged side by side, as in the illustration below. The road managers have analysed tailbacks at lights so that they do not impede movement of the tramway or its access to stations.


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Illustration 18: Traffic lights in the general traffic area in Reims

Some general traffic areas are only open to local residential traffic. The entrance to the site is then equipped with no-entry signs supplemented with "except for access" plaques.

To limit problems related to opening gates onto resident access, on certain networks, the inhabitants of the streets concerned can have their gates motorized. Local residents will also find it easier to see and be seen if they leave their property in the forward direction.

2.8 Parking management

Parking management varies greatly from one site to another. It is sometimes tolerated, prohibited or regulated, each site having its own specific features.

In Nantes for example, parallel parking is permitted parallel to the general flow of traffic. Experience shows that this type of parking can create conflicts with trams when manoeuvring vehicles or opening doors.

Illustration 19: Parallel parking in Nantes

In Reims, to avoid conflicts with the tramway, a side lane was created with parking areas. In this way, vehicle parking does not impact the movement of trams.


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Illustration 20: Side lane devoted to parking in Reims

To effectively restrict parking in areas where it could be problematic (masking visibility, leading to insufficient road width, overlapping onto the tramway swept path, etc.), some networks have fitted bollards.

Illustration 21: Bollards restricting parking in Nantes

3. Recommendations

3.1 When can a general traffic area be developed?

When the total width does not allow sufficient space to be allocated for each mode of transport, and the choice is made not to do away with any urban function, developing a general traffic area makes it possible to offer a tram service while maintaining motor vehicle traffic.

Illustration 22: General traffic area in a residential area in Toulouse

The development of a general traffic area is appropriate on roads with low traffic (up to about 5,000 veh/day in both directions combined) and few intersections[5]. It is essential for traffic flow to be free-flowing on the road concerned, because tailbacks penalize the level of service of the tram.

Illustration 23: Tram in uncontrolled general traffic (Ghent)

When a general traffic area is set up on a road with little traffic, the potential increase in traffic should be evaluated. Development of housing around the tram lines may lead to an increase in traffic and cause traffic conditions to deteriorate in the long term.

It is preferable to set up a general traffic area on a road where car drivers travel at speeds compatible with those of the trams, which reduces the risk of overtaking and guarantees a better level of safety.

The impact of parking on progress of the tram should also be assessed. This is because a substantial density of shops could lead to unauthorised parking in the general traffic area.

In order to maintain an acceptable level of service throughout the line, the length of the general traffic area must be limited.

The move to a general traffic area may slightly downgrade the level of service of the tramway, but it is often a better alternative than a single lane, which causes more operating difficulties.

5 Not taking into account any pavement structure and drainage design constraints not addressed in this factsheet.

3.2 How to develop a general traffic area

3.2.1 Linking sections

- *Make the layout clear*

Clear infrastructure is an essential factor for proper functioning of the area in all cases. When only one lane is in a general traffic area, it is particularly important for car drivers to be able to distinguish on the ground a lane in a general traffic area from a dedicated tramway lane.

Illustration 24: Dedicated corridor identified by grassing in Nantes

- *Control of speed and overtaking*

General traffic and trams must move at comparable speeds, in order to prevent any attempt to overtake. If overtaking is observed, the use of dissuasive separators, or if necessary, ones that cannot be crossed by motor vehicles, may reduce this. This is all the more desirable when one of the two tramways is in a dedicated lane.

Discontinuing the separator around accesses to residential property must then be examined in line with the general traffic scheme.

In any case, it will be necessary to ensure that the separators are sufficiently contrasted to be easily identifiable by vehicles running in the general traffic area.

Illustration 25: Central delineator to prevent overtaking and U-turns in Angers

- *Accommodating cyclists*

The needs of cyclists must be taken into account from the start of the project. A cycle path or a parallel, alternative route can limit the number of cyclists on the site, which may be dangerous because of the rails.

If it is not possible to create a cycle path away from the general traffic, it is preferable for cyclists to have a minimum width of 1.30 m to the right of the tramway swept path (1.50 m where there are parked cars or barriers) in each direction of travel.

Illustration 26: General traffic area with cycle lane in Nantes

- *Pedestrian crossings*

The location of pedestrian crossings must be commensurate with the needs of pedestrians, and must reflect their preferred route. They must be positioned so as to be consistent with the main areas of pedestrian flow and points of interest.

For pedestrian crossings, two cases are to be distinguished.

If the crossings are equipped with lights, it is recommended to use statutory markings for pedestrian crossings along the entire road, in order to manage conflict between pedestrians and other vehicles. This ensures safe crossing while maintaining the right of way for the tramway. Since R25 lights are reserved for dedicated corridors, only R12 signals can be installed in a general traffic area.

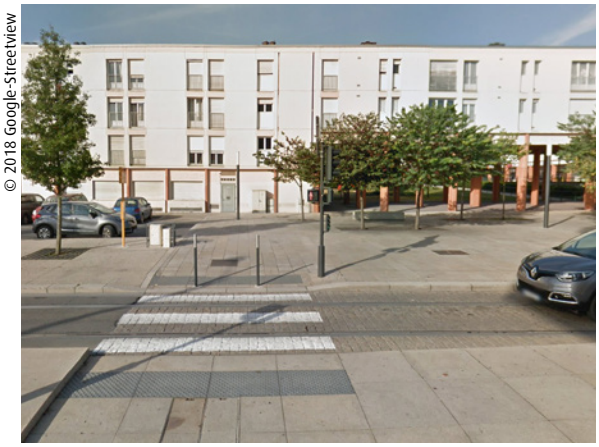

Illustration 27: Pedestrian crossing managed by R12 in Reims

If the crossing is not equipped with lights, the statutory marking may be confusing with regard to the right of way of the tramway over pedestrians. In this case, it is advisable to suggest pedestrian crossings in a visible way, for example by using different surface coverings but without using statutory marking. However, this is acceptable only if traffic is light or calm (with the street treated as a 30 kph zone).

The crossing markings must be sufficiently visible for car drivers to locate it and give way to pedestrians in the process of crossing or clearly showing their intention to do so (see article R415-11 of the French Highway Code).

Where crossings have been created, they must comply with accessibility requirements (TWS[6], lowered pavements, etc.). Crossings that take place in two stages must be equipped with islands big enough to comfortably accommodate pedestrians and people with reduced mobility. A minimum width of 2.00 m must be provided, as recommended in the Cerema guides.

Illustration 28: Pedestrian crossing refuge in Nantes

Away from pedestrian crossings, when separators are installed between lanes, it is important to make them visible to pedestrians by the use of visual contrasts, in order to limit the risk of trips and falls.

If a separator is installed, it must be less than 30 cm wide in order to dissuade pedestrians from walking along it.

6 Tactile warning strip.

- *Organize parking*

When the width of the road permits, it is advisable to provide parking close to the site to meet the needs of locals and shopkeepers. Managing parking helps to limit unauthorized parking of vehicles on pavements and roads that may encroach on the tramway swept path and block the tramway.

These parking spaces must be compatible with the development of a general traffic area. Placed longitudinally in relation to the carriageway, they may create conflicts with the tramway when vehicles manoeuvre. It is therefore recommended to place them sufficiently far away from the tramway swept path (at least 50 cm) to anticipate problems of doors opening or parking outside the marked areas. Creating a side lane remains, however, the most effective way to organize parking in a general traffic area.

- *Take into account constraints related to emergency services.*

This problem is particularly serious when the general traffic area corresponds to a confined zone. It may require measures concerning the choice of separators and street furniture, according to the imperatives of emergency service traffic and access to building facades.

3.2.2 Beginnings and ends of general traffic areas

At the beginning of a general traffic area, whether this is located at an intersection or not, it is essential to help trams by allowing them to enter the traffic flow ahead of other vehicles. This is achieved by using traffic lights to manage conflicts with vehicles entering the general traffic area.

Illustration 29: Start of a general traffic area managed by traffic lights in Le Mans

The end of a general traffic area must be clear for car drivers. The layout of an exit can be usefully emphasized by horizontal road markings, such as hatching and direction arrows, and vertical signs. It can also be reinforced by markers and by different surface coverings, highlighting the continuity of the roadway. This can be done, for example, by using paving stones or grass on the tramway track structure, which would allow car drivers to recover from mistakes and rejoin the roadway after a few metres if they have entered the tramway area by mistake.

Illustration 30: End of a general traffic area in Angers with a change of surface covering

If the end of the general traffic area is located at an intersection, the general traffic area should be interrupted upstream, at a distance calculated according to the amount of traffic, so that tailback does not hinder the movement of trams.

Illustration 31: End of a general traffic area upstream of an intersection in Reims

3.2.3 Intermediate intersections and residential access

As traffic is normally limited, intersections within a general traffic area can generally be managed by static signage giving priority to the lane used by the tram. It is better to equip these intersections with "stop" signs rather than "give way" signs, ensuring that they are correctly positioned so that vehicles do not encroach on the tramway swept path.

© Google street view

Illustration 32: Intersection in a general traffic area managed by stop signs in Angers

AB4 (stop) signs must be supplemented by C20c (tramway crossing) signs and A9 (Danger! Tramway) signs to warn car drivers of the presence of tram tracks.

Where mutual visibility[7] is insufficient, or where there is too high a level of traffic, it may be necessary to equip these intersections with light signals[8]. If lights are also used to ensure right of way for the tram, then tailback in the traffic lanes must be carefully controlled to avoid penalising the movement of trams or their access to stations upstream of the intersection. Lights may also be used to manage pedestrian crossings where necessary.

For access to residential properties, a minimum distance of 2.00 m between the edge of the tramway swept path and the buildings must be provided to provide sufficient visibility at the exit.

3.2.4 Stations

When a tram stops at a station, car drivers tend to want to overtake it. This can be dangerous because of the lack of visibility during the manoeuvre. To prevent overtaking, it is recommended either to design the station with an island platform, the platform itself then acting as a separator, or in the case of a station with side platforms, to fit separators that are impassable for motor vehicles upstream of the station. The separators must be contrasted and easily visible to any pedestrians who might cross. They must also be designed so as not to encourage pedestrians to walk on the separator itself.

The stations can be designed either with an island (central) platform or with side platforms. When designed with side platforms, in general traffic areas and elsewhere, it is preferable for platforms to be laid out facing each other. If spatial restrictions are too great, they can be designed with staggered platforms, taking great care with the pedestrian crossings.

Illustration 33: Station with platforms facing each other in Nantes

The station, and more particularly the platform noses, must be designed to limit the risk of accidents with general traffic. To achieve this, it is recommended to contrast them visually by adding reflective strips, and to create bevelled platform noses.

7 See IUTCS fact sheet on determining visibility cones.
8 IISR requires R17 lights to be complemented or replaced by R11v lights in general traffic or shared areas.

In order to manage the movements of cyclists around stations, it is generally recommended to set up continuous cycle paths, which allow cyclists to overtake a tram stopped in the station, without entering into conflict with pedestrians on the platform.

To do this, the layout with central platforms is preferable to that with side platforms.

In confined sites, these developments are difficult to achieve, and so barriers or bollards may be fitted to dissuade cyclists from accessing the passenger platforms and to encourage them to wait in the general traffic area for the tram to start up again.

3.2.5 Dealing with fixed obstacles close to intersections

On all tramway lines, fixed obstacles should be avoided downstream of intersections and resident access, since these are an additional hazard in the event of a collision, as they can cause vehicles to become jammed between the tram and the obstacle[9].

This subject is particularly important in the case of general traffic areas, most of which are in confined spaces. The appropriate guidance should therefore be referred to for the installation of any potential obstacle, in particular separators and items of street furniture.

3.2.6 Operating arrangements

Tram drivers generally apply the same safety rules as for dedicated corridors, according to the principle of driving on line-of-sight.

To allow it to enter the traffic flow and limit the risks of overtaking, the tram should be allowed to run at least at the same speed as the general traffic. So according to the principle of driving on line-of-sight, it is up to the tram driver to adapt his/her speed to the context.

It is also recommended, in keeping with the same principle, that tram drivers should keep a safe distance from any cars or other trams in front of them.

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9 See *Guide d'implantation des obstacles fixes à proximité des intersections tramways / voies routières* (Guide for installing fixed obstacles near tram/road intersections), STRMTG 2012.

Further information

- *Rapport annuel sur le parc, le trafic et les évènements d'exploitation des tramways Année 2016 Évolution 2007/2016,* (Annual report on the rolling stock, traffic and operating events of trams Year 2016 Changes between 2007 and 2016),STRMTG, 2017
- *Urban Roads and Streets - Planning Guide*, Cerema, 2016
- *Circulation des tramways en site banal, l'exemple de Saint-Étienne, Reims, Angers, Le Mans et Nantes* (Trams running in general traffic areas: the example of Saint-Étienne, Reims, Angers, Le Mans and Nantes), Cerema, 2015.
- *Circulation des tramways en site banal, Phase 1 (*Trams operating in general traffic areas, phase 1) , Cerema, 2014.
- *Guide d'implantation des obstacles fixes à proximité des intersections tramways / voies routières* (Guide for installing fixed obstacles near tram/road intersections), STRMTG 2012
- *Stations en site banal, rapport d'étude* (Stations in general traffic areas, study report), STRMTG, 2012
- Fiche Vélo n° 9, *Vélo et transports publics,* (Cycling factsheet no. 9: Cycling and public transport) Certu, 2010
- *Actes de la journée d'échanges STRMTG/Certu* (Proceedings of the STRMTG/Certu day of discussion), November 19, 2009
- *Guide d'aménagement de voirie pour les transports collectifs* (Road planning guide for public transport), Certu, 2000

The "Urban insertion of surface public transport" factsheet series

Statutory references

- Article R415-11 of the French Highway Code
- Order of November 24, 1967 and Inter-ministerial instructions concerning road signs (instruction inter-ministérielle sur la signalisation routière - IISR)
- French decree no. 2017-440 of March 30, 2017 related to the safety of guided public transport (STPG)

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