

WINTERMAINTENANCE AND URBAIN INSTALLATIONS

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SUMMARY

During winter time, road users expectations towards road managers is specially pronounced. This expectation is specifically important in urban areas because they could be heavily populated, and because of the diversity of mobility demands. Urban areas could also be defined as places where road safety is implemented through speed regulations by means of specific installations. Road managers have therefore to face each year the winter maintenance of these installations.

There are several ways to ensure the winter maintenance of these installations, the optimum being to conciliate the whole following recommendations:

- the estimations of the specific arrangements for staff training: preliminary reconnaissance of the salting route with the simulation of winter operations in non-adverse weather conditions to anticipate possible difficulties and to establish corresponding actions,
- determination of appropriate actions to ease local winter maintenance operations:
 - o marking of installations before the winter period,
 - o setting of specific instructions,
 - o adaptation of devices according to local specificities,
 - o installations of de-icers "containers" in strategic locations,
 - o manual snow-plowing,
 - o installations of removable speed regulators,
 - o changes in parking regulations according to seasons,
 - o ...
- anticipation in projects development: moderate speed regulators induce constraints depending of their locations and winter severity, city winter vehicles and the entity in charge of the maintenance. A proper integration of these constraints might avoid a future change in the urban installations, or their early degradation.

The aim of this communication is to introduce French recommendations in winter maintenance of urban installations, suggested by CERTU (French acronym for Center on networks - transport, urban planning and public buildings) through a note on basic knowledge.

KEY WORDS

INSTALLATIONS / URBAIN / ROAD SAFETY / SPEED MANGEMENT / WINTER MAINTENANCE

1. INTRODUCTION

One of the national strategies of road safety consists in controlling the speed of the motorized traffic. This management can be declined through road installations (roundabout...) or speed-reduction gear devices (chicane, raised sections...). The latter consist in creating a rupture in the route by reinforcing the urban character of a roadway system so that the driver adopts good behavior and decreases its speed.

However, these installations, generally urban or in agglomeration entrance, generate potentially winter operational difficulties.

This note has thus as an ambition to bring a lighting to the winter management of these installations.

The first part of this note will attempt to have the concept of the speed management in urban environment and anticipation of the difficulties related to the winter maintenance at the time of the phase of design. The second part will present the context of the winter maintenance in urban environment and its possible margins of evolution with respect to the adjustments of roadway systems. The tracks of answers to the requirements of each one will be presented in last part. This chapter relates to local specificities to take into account and the general methods of design and exploitation on the great families of installations.

2. PROBLEMS

The speed control by installation is difficult to reconcile with constraints of winter maintenance. The creation of an installation to the characteristics allowing the easy passage of a machine of winter maintenance is then insufficiently constraining with respect to the users, in particular of the light vehicles and does not answer the stakes in term of road safety. If the winter maintenance is partial, even impossible, installation created a rupture in the route. Its specific difficulties does not allow the maintenance of the traffic flow under conditions as close as possible to the level of service concerned. It acts, in the facts, to try to improve the cooperation and the communication between the world of the road safety and the medium of the winter exploitation. The problems thus lie in the search for methodological tracks on the basis of current practice aiming at answering the stakes in term of road safety while improving winter service.

3. CONTEXT

3.1. Control speeds by installation

3.1.1. Tools of installation

More than just a regulatory measure [1] [2] [3] , the speed control by installation is a concept that defines the link between the speed limit, the design of the road and the social function of the street, with the aim ensuring safety for all the modes of the transport, while privileging most vulnerable (pedestrians, bicycles).

The decision of installation of a device and rules of circulation associated concern the policing powers of the mayor after consultation the authorities managers the roadway.

The tools for installation allowing this control are varied according to the types of roadway systems and their uses. They can be distributed according to four approaches:

- The reduction of the traffic lane width: this dimensioning of the profile transversely is related to three elements: the vehicles width, the margin for manoeuvre and safety

margins. This reduction can be visual or physical, imperative or be tolerated at low speed, with or without going beyond the affected ways.

- Variation of the longitudinal section: this involves using the longitudinal section (project height measurements) to indicate to users a different mode of operation and help to control speeds through the discomfort generated (round-top speed hump, trapezoidal speed retarder, speed cushion, speed table...)
- Deflection of trajectory: Deflections of trajectory are a basic urban planning and road user behaviour control measure (chicanes, alternate, mini-roundabout...),
- Modification of the space structuring (variation of the course, the visual framework, use of junctions as space-structuring elements)

These installations can be carried out containing materials of different colors or textures from that of the roadway. They are also to be materialized by an adequate indication and sometimes, the installation of urban furniture or the installation of plants [11]

3.1.2. Possible margins of evolution

To answer the stakes of road safety, the installation of speed-reduction gear devices on an existing network should not create Preference Areas with the formation of glaze or the retention of snow. Certain basic rules must be observed:

- To avoid any installation initially where the return to an adherence in conformity with the level of service concerned would be done only by the means of road anti-icer or de-icer, economically and ecologically inadmissible method.
- To avoid the formation of low points and the changes of incline favourable with the retention of water and thus with the formation of ice. The management of rain water and surface waters resulting from the melting of stocks of snow is imperative to avoid the formation of ice. (the knowledge of the inopportune formation of ice concerns the normal permissive waste).
- To pay a detailed attention to the coatings used which, by their characteristics, can modify the thermal behavior of the road. A coating of color darker than the roadway radiates in a more significant way. This property generates significant falls of the temperature of surface at the time of particular weather phenomena. In the same way, the coatings retained for their phonic properties retain quantities of water more significant than the traditional coatings. For example, the quantities of water intercepted by road surfaces, in the presence of a medium-heavy traffic, are estimated at [4]
 - Asphaltic concrete semi-granularity 0/10 mm: 100g H₂O/m² at the end of the drainage (water intercepted by surface macrotecture)
 - Asphaltic concrete draining: more than 300g H₂O/m² at the end of the drainage (water intercepted in internal porosity)
- To avoid the creation of solid drop shadows by the realization of installation landscape often used for the structuring of space, in particular for the baffles in city entrance and expressways. -
- To prevent the creation of a water film generated by different coatings (paved, stone) or by horizontal marking (presence of reflecting balls of glass). This film can reach easily a thickness of 50 µm, sufficient for the formation of ice.

3.2. Winter viability in urban environment

3.2.1. Specificities of the urban environment

The French urban environment is characterized by a network generally with a grid shape. The roadway systems raise of the responsibility for various managers describes hereafter. As for the operations of winter maintenance, they depend only on the policing powers of the mayor on any type of roadway system in the crossings of agglomeration[1] In practice,

the continuity of the level of service on the same route is dealt with by the person responsible for the road infrastructure. This report leads us to establish the following characteristics of the urban environment:

- multiplicity of the actors: four categories of actors, except police force, are concerned with winter viability:
 - Planners which designates the legal entity responsible for the road infrastructure (the commune for the communal ways, the general council for the road secondary...),
 - the road manager charged to set up winter maintenance in comparison with the objectives laid down by the control of work (generally engineering departments of the local authorities),
 - the operators (engineering departments, subcontractors...)
 - road users [6]
- multiplicity of the equipments used: the machines of winter maintenance (ESH) definite as such are freight vehicles of goods, gross weight superior with 3,5 tons, or farm tractors since they are equipped with tools intended for the fight against the ice or snow [7] The first quoted category is generally used on networks with strong traffic, of share their power and their gauge[8] [9] The second category is more generally dedicated to the rural medium and the small agglomerations. This statute of ESH was created to regulate the work of the owner and to limit the recourse related to the aspect of accident of the équipement. However, under less legal cover, the owner has the possibility of ensuring his winter maintenance with other type of material. Consequently, there is a large variety of material of gauge lower or equal to 3,5 tons used in urban environment: sweepers, equipments of cleaning of roadway system equipped, mini-tractors...

3.2.2. Strategies of exploitation

The recommendations as regards winter maintenance of the urban environment tend to encourage the communities to transfer and adapt the national strategies [10] Thus, of the levels of service is assigned to different the type of roadway systems of the network. These levels of service represent the image of the priorities which the communities give each other. They must be compatible with climatic realities, needs of the various users, specificities of the network and thus will make it possible to treat in an ordered way the various roadway systems according to their structuring importance and of the desired priorities of mobility. These levels of service are declined in qualitative aims which directly impact the modes of intervention implemented [6]

- "mechanized interventions" carried out mainly on the roadway systems and which call upon machines of winter maintenance (ESH) of conventional type or with machines of smaller gauges (material of cleaning of the roadway system equipped for winter viability...)
- "manual interventions", carried out on the whole of the roadway systems pedestrians, cycle tracks, access to the public buildings, and which implement either of the small motorized equipment (cutters, mini-tractors...), or of the manual materials (snow shovel, manual spreaders...)

These two great families of intervention can be declined according to strategies preventive and/or curative.

The choice of the strategy and the modes of interventions thus depends on the complexity of the roadway systems and the capacities in materials, human and financial average.

Moreover, in urban aera, the circuits of intervention can be distinct according to phenomena's to treat. On the function spreading, the mixing and the transport of road de-icer by the traffic allow the standardization of the treatment on the network. The principal problems are then related to the sensitivity to road de-icer of the environment close to the treated roadway (corrosive materials, plants...). A contrario, the function removing is fulfilled on the near total of the roadway systems and requires a perfect knowledge of the

road network, its singular points and its interactions with the related roadway systems. The problems are primarily on management of the cords of snow, the discharge points and on space necessary to the passage of the tools for removing.

3.2.3. Possible margins of evolution of the winter service

The creation of an installation on an existing network modifies the characteristics and directly impacts of them the balance of the organization of the winter maintenance. The upgrading capabilities of the winter maintenance to answer the objectives in term of road safety lie in:

- the adaptation of the equipment: the suppliers propose today a large variety of equipment adapted to the urban environment (small gauge, blade with retractable elements, stems transformable, etc). The change of equipment necessary to the treatment of installation can also be carried out by a modification of the circuits of intervention.

- The coherence of the strategies of intervention: In comparison with the policy laid down by the manager with respect to the control speed by installations, the strategies of treatment can differ. The purely curative provisions complex the winter maintenance on the arranged spot. It can then be convenient, on roadway systems on high level of service and dense in speed-reduction gear devices, to support the preventive strategies, which will cause to limit the constraints related to the removing function. This strategy requires the provision of the control of work of means of anticipation.

- The creation of a rupture of treatment: the control of work can decide not to treat installation. This choice must be in coherence with the beforehand definite levels of service. It must then set up an indication of danger, except in "30 km/h aera", aiming at drawing the attention of the users to the presence of obstacles or dangerous points related to the state of the road [11] Share its seasonal character, this indication also concerns temporary indication and must be deposited except winter period [12]

The control of work must thus position upstream project of installation on the modifications of the winter maintenance to estimate the impact and to take adequate measurements of it.

4. THE CONCILIATION OF NEEDS

4.1. Project control

As explained above, the dialogue with the services in charge of the winter exploitation is strongly advised upstream project in order to avoid any modification or later degradation of the device. The integration of these constraints can generate additional costs which must be estimated in the estimated budget of the operation. After realization of the device, the reception of installation can be operated by the passage of the winter maintenance equipment, provided this procedure is mentioned in the schedule of conditions.

Before any winter season, it is advised to carry out a preliminary recognition of the course by simulating an intervention, method which makes it possible to anticipate the difficulties suitable for be encountered there. For complex installations, specific provisions of exploitation can installation (formation with the control of the machines of winter maintenance or manual snow clearance, two persons in the truck, modification of the orientation of the blade, etc.)

4.2. The taking into account of local specificities

4.2.1. The evaluation of the winter difficulties

France is a country contrasted in the rigour of its winters. To evaluate the bad weather having consequences on the adjustments of roadway systems proves to be a relatively complex exercise. The analysis of some parameters frequently raised by the weather services allows a first approach of the winter climatology of the site of installation (a number of days of freezing, of snow falls, presence of ice, importance, duration, intensity of precipitations, thickness of snow, snow-drifts area, etc). The typological analysis of these parameters and the events makes it possible to carry out choices aiming at a better adapted winter exploitation. The data height of snow stresses the typology of the edges to be used (to prefer flush kerbs for a easier evacuation of snow).

4.2.2. The dimensioning of the equipment park

It is essential to define the dimensional specifications of the equipment park used during the creation of an adjustment of roadway system.

Failing to contact the winter maintenance departments, the designer can also refer to gauges of standard ESH. Some software allows to define, calculate, and draw gyration possibilities of all vehicles, and to check the adequacy of an installation to the constraints of traffic[13]

4.2.3. The nature of the traffic

Function of the hierarchy of the arranged route and the nature of the traffic, the characteristics of the reducing device will be more or less constraining with respect to the users. If installation is on a route at exceptional convoys, space necessary to the passage of a machine of winter maintenance is sufficient, just as for the networks with strong circulation heavy lorries. On the other hand, if installation aims at restricting the speed of the light vehicles, the integration of the constraints of winter viability finds all its relevance.

4.3. General methods of design and exploitation of installations

4.3.1. Profiles transversely

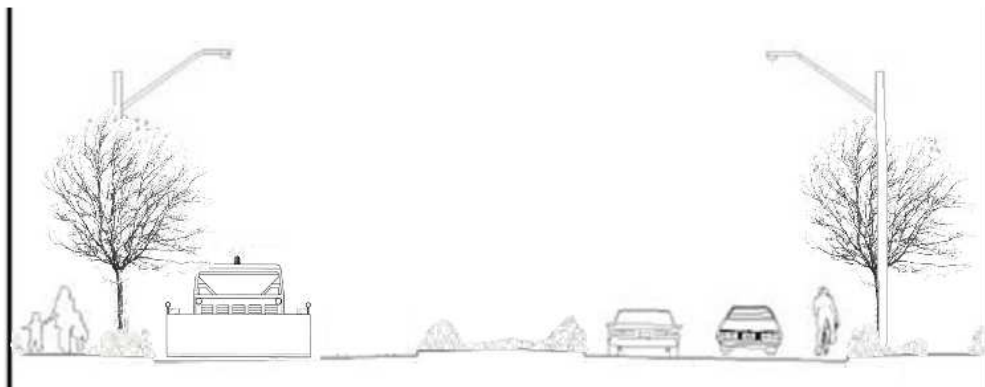


Figure 1: Schematic profile transversely

Beyond the strategic tool of regulation speed, the treatment of the profiles transversely allows a distribution of space for a better cohabitation between the various users. The elements of variation can be at the level of the separators of roadway systems, the parking, the circulable width, the variety of the coatings, etc.

The width of circulation for the light vehicles should not be oversized. However, it is possible to envisage storage sections but it's necessary to move away the obstacles located in the vicinity (removable barriers, candelabra...) and envisage the collection of surface waters resulting from the melting of the snow-covered deposits. These storage sections should not encroach on the advance of the pedestrians [15]

The lanes can also be marked out edges without causing of embarrassment to the passage of the tool for removing or the evacuation of snow. The marking out by low wall blocks the operations of removing: snow agglomerates along the continuous walls and thus reduces the working width of the roadway (except integrating an operation of evacuation of additional snow).

The treatment of the profile transversely by the means of the parking requires the information of the users as for the incurred risk of snowing up of the vehicle. Winter parking regulations may be implemented by the regulation of the parking thus avoiding the bogged down and/or damaged vehicles (total or specific prohibition to station).

The adjustment of the profiles across the roadway systems (presence of narrow gauge railways...) raises difficulties related to the accessibility of the vehicles conventional heavy lorries. In this case, it can be resorted to vehicles of the 4x4 type or equipment of roadway system and park reconverted by equipping them with a blade and a spreader; These materials can be of quads type, tractors, self-supported mowers, sweepers...

For the roadway systems bordered of cycle tracks (extra width of roadway dedicated to the cyclists), the blades of snow clearance to cross slides offer the possibility of snow clearance over a variable width. This choice implies that the manager judged relevant to ensure the viability of the cycle track in winter period. It must thus offer to the user cyclist a level of continuous service on the whole of its route (release of the bands and cycle tracks).

4.3.2. Profiles longitudinally

One of the means of moderating speed is to set up heightenings of all or left the roadway which gather:

- Speed table (in current section or crossroads),
- Trapezoidal speed retarder,
- Round-top speed hump
- Speed cushion
- "rough bands" (generally installed with 50 meters of the entries of agglomeration).

These devices are often highlighted by the use of materials of color, texture different and an adapted vertical indication.

The flux lorry drivers spreading does not raise particular problems. On the other hand, the traditional tools for removing must be used in "flotting". This type of use does not make it possible to minimize the residual film of ice/snow. The special blades of snow clearance (blades by sector, obliteration, retractable elements) make it possible to optimize removing. In reality, it is generally resorted to the manual snow clearance, even if he is a consumer of additional means.

4.3.3. Trajectories

This tool for installation makes it possible to intervene on the control and in particular on the speed of the users but also on the perception and the distribution of spaces. It is based on the variations of the radii of curvature, the baffles or the offsets of roadway.

The variation of the radii of curvature must be materialized by edges not causing embarrassments with



the machines of winter maintenance nor to the evacuation of snow.

There are various baffles of which the use is a function of the type of roadway system.

The baffles without central small island or alternate are generally located in the zones limited to 30 km/h and thus on networks to low level of service where the winter exploitation is connected with that of the pedestrian precincts.

As for the baffles with central small island, they are recommended in entry of agglomeration and in the streets of which speed is limited to 50 km/h. The code of practice as regards design of this type of installation makes desirable the presence of a side track. If this way is immediately contiguous with the roadway, by a diverted function, it allows to facilitate the passage of a machine of winter service [14]

The offsets of roadways constitute a rupture of cross-section with release of space side. They use the parking, the projections of pavements or the plantations to facilitate the crossings and to encourage with the moderation speed. These side spaces can constitute surfaces of storage.

In the zones at the snow-covered risks high, it is common to resort to visible means which make it possible to delimit the influences of the roadway. These "guides" are carried out upstream winter season and allow, once the snow cover covering the roadway, to guide the driver at the complex places.



4.3.4. Intersections

The problems of the crossroads in winter period and under snow-covered condition generally reside in the safeguarding of the space dedicated to each user by an optimal management of snow.

For the traditional crossroads, the tendency to the creation of advanced pavements, is today called "ears" whose function is to reduce the length of the advanced pedestrians. These ears induce the modification of the characteristics of the machine of winter maintenance to adapt it to the reduced widths circulable. They cannot constitute places of storage of snow because of the presence of roadway systems pedestrians. To date, the manual snow clearance remains effective means of action.

The roundabouts form part of the French road landscape henceforth. For a few years, the conceptual tendency has been with the reduction of their characteristics, especially in urban environment where the constraints of space are strongest. The roundabouts can be treated only on the circulated tapes. They in addition constitute a space of reversal adapted at the end of the circuit. In fact, and generally fault of coordination, it generally results a road flux overdose from it.

The change of direction in this type of crossroads is usually guided by the presence of channelising islands. In urban environment, the small islands can be materialized by edges, painting or coatings different from those of the roadway. However, when these small islands have as an aim principal the protection of the pedestrians, they must be delimited by raised kerbs[16] The chamfered flush kerbs are those which cause less embarrassments with the passage of a machine of winter maintenance. To answer the requests of the tool for removing, it is necessary that they are embedded in the structure (standard I2 or I4). The stuck edges (I1 or I3) are to be prohibited because they do not resist a long time wrenching by the blade [17]

The organisational methods on the level of the intersections must clearly definite and be stated in the documents of exploitation of winter viability: identified discharge points, evacuation of the cords of anticipated snow.

4.3.5. Urban furniture and vegetation

The risks dependent on urban furniture and the vegetation, in their diversity and their frequency, present on the pavements or the verges are:

- to obstruct the passage of the machine of winter maintenance provided with its blade because of their too close establishment
- to be degraded by road de-icer spreaded.

They must be established remotely of the working areas, the studs must be off-set kerb of pavement to avoid any damage due to the offset of the tool for removing (minimal distance from 20 to 30 cm), the materials corrosion resistant are preferable, just as a halophilous vegetation.

The removable devices can also be retained, they make it possible to control the traffic in estival period and to be dismounted in winter period. The flower vats constitute an aesthetic system of distribution of space between various users in summer. Vegetalized spaces systematically do not constitute places of storage of snow, they suffer damage due to the presence of road fluxes in snow and permeable surface supports the penetration of the saline effluents in the substrate.

5. CONCLUSION

These investigations were carried out at the request of the CERTU in front of the difficulties encountered by the cities in the field of the winter maintenance of the urban developments. Indeed, force is to note that the designers and managers have only few information and that the request on the subject becomes pressing.

The characteristic of the urban developments lies in their single character. Their exploitation requires on behalf of the manager a perfect knowledge their intrinsic characteristics and of their surrounding medium. The strategy of winter maintenance must then be in coherence with the policy of road safety defined by the city. The organization which results from this can use average materials many and varied present on the market. But the pivot of this organization remains, in addition to the communication with the user, the know-how of the operators.

Other skew making it possible to reconcile road safety and answer to the user in term of adherent quality in winter period lies in the design of the device, with an integration as of the first phase of the project of constraints of exploitation.

The current technological developments can assist the managers in their step. The control of the spreaders to residual salinity or the remote piloting of the orientation of the discs of spreading is solutions which can find their relevance in urban environment.

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