

# ROADS, STREETS AND PUBLIC SPACES, THE URGENCY: MAINTAIN, ADAPT, MODERNISE.

## 

# Roads, streets and public spaces, what uses, how to adapt and maintain them?

Dear partner, elected official, member of a municipal team, field player, do you know that you are the owner of an important heritage, apparently banal and yet rich in innovations and challenges?

This heritage is the network of roads, streets and public spaces that serve your municipality, wind through your countryside and irrigate your territory. The one that all our fellow citizens use day after day without even thinking about it. Yet, without roads and streets, you cannot drive, you cannot cycle, you cannot take a train, you cannot take a boat, you cannot take a plane... Roads are essential. It must be adapted to the new modes and uses of travel that are emerging, by integrating the rapid evolution of digital technology.

The first social network before its time, it connects your citizens and facilitates their daily lives, promotes economic exchanges and access to services, fights against rural desertification and contributes to the good life together.

The French road network is one of the most remarkable in Europe, accounting for almost 87% of the movement of goods and people and representing a cumulative value of 2,000 billion euros. Unfortunately, this network is deteriorating over the years due to the impact of traffic and bad weather, and often due to a lack of maintenance.

There are warning signs, but there is also technical progress. With the advent of innovative construction and maintenance techniques, sustainable equipment and connected infrastructures, the strengthening of road safety and signalling requirements, and the introduction of quality indicators, roads are providing solutions.

We thought it would be useful to accompany you facing these major challenges, to provide you with the keys to understanding, to remind you of the know-how of our technical experts and to present the range of solutions adapted to your situation.

This booklet is designed for you as a practical guide to answer these basic questions: what are the uses of public space today? What innovations allow roads to meet the challenges of the energy and ecological transition, and finally what is a road, how to maintain it, how to adapt it and modernise it?



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# ROADS, STREETS AND PUBLIC SPACES: TOWARDS NEW USES



## As our country's largest social network, roads and streets are at the heart of all mobility.

Today, they account for almost 87% of the transport of people and goods, and everything leads us to believe that they will remain so for a long time to come. The digital and technological revolutions are changing the

way people travel, bringing new services and new connected or autonomous vehicles. They will always require roads and streets to be in good condition, adapted and modernised.

The next few years will see an increasing demand for sustainable and efficient mobility solutions. The state and the citizen of the 21st century are primarily concerned with optimising travel: they do so for economic, ecological and practical reasons. As a result, the use of roads, streets and public spaces is changing rapidly..

In urban areas, soft modes are developing very rapidly: bicycles, electrically assisted bicycles and «urban gliding» products (gyropodes, solowheel, hoverboards, skateboards, rollerblades, etc.).

The latter encroach on pedestrian space or the roadway, with the risk of increasingly frequent collisions. The infrastructure needs to be adapted and modernised, in particular by reserving dedicated lanes equipped with specific surfaces and signs.

In interurban and rural areas, on-demand mobility, car-sharing and car-pooling divide the costs and minimise the environmental impact.



Whatever the environment, the various types of vehicles are gradually being «decarbonised», their connected equipment rationalising driving and traffic. In addition, the development of sharing, both of data and of vehicles, and the 'intelligent' integration, from point A to point B, of the various modes of transport, whether collective or individual, autonomous or not, will undoubtedly constitute the transport supply model with the greatest potential: that of optimised personal mobility 'on demand'.



Thus, developments in favour of this «connected mobility» will not be achieved without adapting road infrastructures and their equipment (horizontal and vertical signs, connected objects with local or remote reach, emergency stops, etc.) or without changes in network operation (new role of the manager). Road infrastructures and road signs will have to provide information - locally or remotely - to signalling systems, in-vehicle navigation systems or via smartphones, remote traffic management systems, etc...

## INNOVATION FOR ROADS, STREETS AND PUBLIC SPACES



In recent years, technical innovations in roads, streets and public spaces have come on strong, bringing significant improvements for users and residents, making the road safer, more environmentally friendly, more enjoyable and more sustainable.

The autonomous vehicle will communicate intensively with its environment through the road infrastructure, other road users and other vehicles. The infrastructure will have to be readable by the automatic driving software and will have to inform the autonomous vehicle of local parameters that can help the navigation and driving system. The possible uses of the autonomous vehicle, whether it be a fluid motorway, driving in congested situations, automatic valet parking or automatic mini-buses, will therefore require adaptations to the infrastructure and new rules for sharing road space.



## SAFETY

Behind the technical terms, many innovations now make it possible to improve the safety conditions of users:

• **High-grip** pavements reduce braking distances in sensitive areas such as junctions and pedestrian crossings.

• **Porous asphalt** provides optimum visibility and better road holding in the event of rain (suppression of aquaplaning).

• Thin overlays provide (or restore) grip, smoothness and/or noise reduction to the tyre-pavement contact.

• Light-coloured or «glittering» asphalt mixes have proved their worth in tunnels and on the approach to danger zones by improving drivers' awareness of the environment.

• In terms of equipment and signage, numerous innovations, such as horizontal and vertical signage, variable message signs and more effective restraint systems, have also helped to increase safety for all.

As a general rule, safety is ensured as soon as the infrastructure is designed, and then by: systematically treating black spots, creating roundabouts, and making the road twice as wide with dividers and level junctions...

In the future, with the development of the autonomous car, safety will depend on the vehicle and the infrastructure.



## THE ECOLOGICAL TRANSITION

In order to reduce the environmental footprint of its activity, the road industry has developed new products and processes, including **material recycling**, thanks to the «research and development» departments of its companies and in close collaboration with its clients. As a model of the circular economy, roads are recycled in the bituminous materials used for road maintenance. Innovative products include warm mixes, asphalt mixes that capture nitrogen oxides and the SEVE eco-comparator, which enables project owners to find the best

technical variant from an environmental point of view in the context of calls for tender.



## THE ENERGY TRANSITION

## Roads, lighting and energy: what innovations for municipalities?

**40% of public lighting is more than 20 years old!** Nearly half of the public lighting stock is therefore obsolete and energy-intensive. However, modernising this stock is a very important lever for the energy



transition. The Association Française pour l'Éclairage (French Lighting Association) estimates that between 40% and 70% of energy savings can be made on the current lighting stock.

Synergies between several types of infrastructure can go even further! The choice of a light-coloured road surface combined with the conversion of the lighting fleet to LEDs and the installation of a detection system for passing vehicles or passers-by can reduce the public lighting bill by **up to 90%** while limiting light pollution.

The pavement can also be equipped with heat exchangers under the wearing course to capture thermal energy, store it and release it for various applications (heating of buildings, snow removal, etc.). This reversible equipment can also contribute to the fight against urban heat islands.





**Finally, the use of photovoltaic panels** on road surfaces, whether or not they are paved, ensures the energy autonomy of facilities near the road.



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## **THE COMFORT**

Because comfort and safety often go hand in hand, the new surfacings proposed by manufacturers provide an effective response in terms of both road holding and driving comfort.

The noise comfort of road surfaces has also made significant progress, thanks to the innovation of **noise-reducing mixes** which, over time, significantly reduce noise pollution for local residents (3 to 5 db).



all sound energy is **reflected** 

**Porous** covering part of the sound energy is **absorbed** 

## LENGTH

The service objective imposed on any road infrastructure has three watchwords: safety, accessibility and fluidity. Three criteria to which must be added the essential objective of **longevity**.

This issue is primarily the responsibility of the project owner, advised by the design offices and contractors. As the manager of road assets, it is up to the local elected official to find the best solution to preserve his assets while optimising public expenditure.

It is through a precise knowledge of the life cycle of a pavement and of existing technical solutions that a local authority can anticipate its needs and determine its maintenance policy at the right cost.

The French road network represents more than 1 million kilometres of which :

- 673,290 km of municipal roads
- 378,973 km of departmental roads

• 21,492 km of national roads including 9,112 km of motorways under concession



# MAINTENANCE OF THE ROAD



Roads and streets deteriorate over time as a result of traffic and climate. At first discreet, wear and tear can reveal itself and accelerate sharply as soon as the first cracks appear. Only regular and appropriate maintenance can extend the life of the network, save money and provide users with good safety conditions and driving comfort.

## HOW DOES THE ROAD DETERIORATE?

The most common types of damage encountered are at different levels of the roadway:

## The wearing course

• Wear and tear of the wearing course aggregates (progressive loss of skid resistance)

• Wear due to tangential forces exerted by rolling loads.

• **Creep rutting** (extreme temperature and traffic conditions).

• Fatigue cracking by disbonding of the surface layer from the base layers.

• Cracking due to rising cracks in the base layer.

• Thermal fatigue cracking due to bitumen ageing.

• **Crazing** (localized network of cracks) followed by the departure of materials and the appearance of **potholes** 

These cracking processes lead to a loss of waterproofing of the pavement!

## The base layers

• Rapid aggravation of the pothole

• Fatigue cracking due to repeated tensile bending forces.

## **ROAD REHABILITATION**



Water is the number one enemy of the road.

Infiltrated through the pavement by cracking, or in the embankment by poorly maintained ditches, it can deprive the support of all bearing capacity, leading to premature fatigue of the pavement, or even destructuring of the support due to frost phenomena during the winter.

The drainage of rainwater and the proper drainage of water under the roadway are therefore major concerns.

Both operations require the establishment and maintenance of a continuous network of specific works for four distinct purposes: • Collection of surface

water by ditches and gutters.The collection of deep

 The collection of deep water by drainage works.
 These systems capture

Structural road

wear:

1 loaded truck

1 million cars

the water and facilitate its evacuation to the outlets.

- Concentration and evacuation of water through gutters to the drains.
- The discharge of water into the hydrological network.

Before the final discharge of the water, decantation and filtration structures allow for the retention of any polluting residues (hydrocarbon spills, dangerous products spilled following an accident).

## MAINTENANCE POLICIES

In the context of good management of road and street assets, the implementation of a maintenance policy is essential in order to avoid emergency rehabilitation work as much as possible and to favour programmed operations.

Carried out as part of **preventive maintenance**, their objective is to prevent deterioration from reaching a critical threshold that could jeopardise the conservation of the pavement, the safety and

87% of freight transport and 87% of passenger transport is by road

1 € not invested in

maintenance can generate

more than 10 € of additional

expenses a few years later!

comfort of users or the integrity of the surface layer. General or specific maintenance missions, these intervention techniques allow :

- Maintain the load distribution capacity of the network, which means keeping the pavement structure in good condition and adapting it to the evolution of trafic.
- To ensure satisfactory safety and comfort conditions for users.

• Maintain the integrity of the surface coating and through it, the protective role of the lower layers

## **GENERAL MAINTENANCE**

The identification of a specific problem in the pavement is based on a diagnosis of its condition established from surveys of two types of deterioration:

## - Surface damage

When the damage is localised fissures, small radius rutting, partial stripping, small potholes, the road structure is not to blame. These simple surface degradations are then treated by repairing the wearing course or surface, with or without reprofiling.

## - Structural deterioration

When the deterioration is of the type of edge collapse, permanent deformation, pothole, generalized crazing, large radius rutting or generalized cracking, it is the very structure of the pavement that is damaged. Major reinforcement or resurfacing work must then be considered.

Only a regular diagnosis can

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tell you the condition of your pavements! ROUTES DE FRANCE

## THE MOST FREQUENT INTERVENTIONS

We have selected four of the most common types of wear and tear and the actions to be taken to remedy them:

**1. The wearing course aggregates polish** under trafic and the pavement gradually loses its roughness, resulting in a lack of surface drainage and loss of vehicle grip on wet pavement.

The safety of users is compromised.

## Solution :

• Strengthen the grip.

**2.** Cracks appear on the pavement and gradually open up, particularly by lip spalling.

Field observations:



• Transverse fissures are often due to the rigid nature of the structural layers.



• Longitudinal fissures and mainly located in way of the passage of the wheels show a structural weakness.



Without proper maintenance, these fissures develop into cracks, resulting in water penetration and structural weakening of the pavement.

## Solution :

• Ensuring watertightness

• Reinforce the structure if it is not (any longer) adequate for the amount of traffic.

**3. Potholes multiply.** This stage of deterioration usually occurs after the wearing course has cracked. Material is stripped from the wearing course, defects deepen and become potholes in all or part of the thickness of the wearing course or even the underlying structure.

During rainfall, water stagnates and penetrates the interface of the layers and towards the bottom of the structure, the deterioration of the road progresses rapidly, especially during the winter.



## Solution :

- Emergency repair
- Treat adjacent cracks before they develop into potholes

4. The cross-section of the roadway deforms under the trafic (at wheel arches, at the edges). These deformations disrupt the direction of travel, causing a risk of loss of vehicle control. The hollows retain water that penetrates the ground when a crack is added to the deformations.

## Solution :

- Correcting deformations
- Reinforce the structure if it is not (any longer) adequate for the amount of traffic.





## **EXAMPLES OF MAINTENANCE TECHNIQUES** (non-exhaustive list) with order of magnitude of costs

Note: the condition of the existing road and the traffic determine the appropriate technique, not the cost.

OVER-SEAL BANDING	Treatment of cracks	A bituminous mastic technique for sealing cracks, limiting the degradation of the edges of the crack and waterproofing the road.
APE	Automatic patching equipment	The purpose of the patching equipment is to repair the unrolling layers of the pavement at isolated points where they show surface deterioration: cracks, crazing, shipping, potholes, etc
SD ( > 3 € HT/ m²*)	Surface dressing	SD is a very thin wearing course laid in situ and consisting of layers of bituminous binder and chippings spread successively. The renewal of the wearing course in surface dressing makes it possible to restore the waterproofing and skid resistance of a complete section of the road.
MS ( > 5 € HT/ m²*)	Micro-surfacing	Micro-surfacing is made of aggregates coated with bitumen emulsion and laid by thin layer casting. The manufacturing and laying operations are carried out in situ, using specific equipment. The material cannot be stored. After placement, it can usually be delivered to traffic very quickly without prior compaction.
ACBE ( > 8 € HT/ m <sup>2</sup> )	Asphalt concrete with bituminous emulsion	Emulsion asphalt concrete is manufactured with bitumen emulsion. It is used outside built-up areas on deformed pavements with average traffic. It can be stored and used to fill potholes.
BBTM ( > 7 € HT/ m²*)	Very thin asphalt concrete	Layer thickness of 2.5 cm. Used in France for wearing courses, when the existing pavement is not very deformed and not very degraded, it makes it possible to produce a wearing course which, after a few years, can be planed and redone or for particular points where a strong macrotexture is sought. Allows for noise control pavements (noise measurement at the facade up to - 5 dB; equivalent to dividing the traffic by 3).
BBM ( > 10 € HT/ m <sup>2*</sup> )	Thin asphalt concrete	The average thickness of application is 3.0 to 4.0 cm. MBMs are applied to slightly distressed and slightly deformed pavements. They can be warm and contain recycled asphalt.
BBSG ( > 13 € HT/ m <sup>2*</sup> )	Semi-coarse bituminous concrete	Widely used in France for wearing courses, they can be «warm» and contain recycled asphalt. Layer thickness approx. 6 cm.

(\*) These 2018 price ranges are just for information. They may vary according to the cost of materials, transport, construction time and specific context of the site, etc..

Indication(s)	Limite of use	Cost	execution
> Waterproofing	Spot treatment	€	000
> Waterproofing > Skid-resistance	Spot treatment	€€	000
> Waterproofing > Skid-resistance Municipal or departmental roads with low traffic volume	Substrate quality Construction period	E	000
<ul> <li>&gt; Waterproofing</li> <li>&gt; Skid-resistance</li> <li>Urban environment or departmental roads with heavy traffic</li> </ul>	Substrate quality Construction period	••	000
> Waterproofing > Skid-resistance Low to medium traffic - reprofiling	Traffic Sensitivity immediately after application	66	00
> Waterproofing > Skid-resistance > Noise	Substrate quality Traffic		00
> Waterproofing > Skid-resistance	Substrate quality	•••	66
> Waterproofing > Skid-resistance	Substrate quality	<b>EE</b>	00

Speed of

ROUTES DE FRANCE

## **TEST:**

Do you know how worn the roads and streets are in your community? Take the test in a few seconds by answering the following questions: Look at yourself:

• wear and tear of the coating?	□ yes	□no
<ul> <li>cracks and/or «crazing» in the flooring?</li> </ul>	□ yes	□no
• deformations of the road?	□ yes	□no
material departures	□ yes	□no
• potholes?	□ yes	□no

Depending on the number of positive responses obtained and the date of the last work on the segment of pavement concerned, you will note the importance of the preventive or curative maintenance operations to be undertaken by referring to the curve below:



In addition, the following additional observations may alert you to take action:

•	degraded signage?	□ yes	□no
•	an increase in heavy goods traffic (or agricultural machinery)?	yes	□no

Heritage value of the French road network = 2,000 billion euros, of which 1,750 for the departmental and municipal network

## CONSTRUCTION OF A ROADWAY



Road construction has become a sustainable development issue. Integrated into its environment, the road uses local, inexpensive materials that can be reprocessed on site.

The surfacings used have environmental virtues that improve working conditions on the sites, reduce nuisance for local residents and offer long-term surfacing quality.

# THE 6 MAIN STAGES OF PAVEMENT CONSTRUCTION

## **PAVEMENT DESIGN**

This is the major stage for the future life of the road. The design is carried out by a specialised «road» design office in order to meet the regulatory and technical constraints (geometric layout, turning radius, rules for the installation of signs, etc.).

The choice of materials, layer thicknesses and appropriate techniques is based on the trafic, the quality of the substrate, the climate (frost) and the service life.

## EARTHWORKS

The objective: to give the future artery its «longitudinal profile», in other words to prepare the design of the entire structure.

Contrary to what one might think, earthworks is one of the most delicate phases of a construction site. It involves constant adaptation to the quality of the ground encountered according to climatic conditions, whose influence can be considerable on the progress of the work.

Earthworks begin with the extraction of earth from high points (excavated material) and then its transport and placement in embankments at low points, or in storage if the quantity is insufficient or the volume is excessive.

The construction of the embankments is done by spreading and adjusting layers of 30 to 50 cm thick compacted by vibrating rollers or by tamping. The objective is to stabilise the backfill and avoid any subsequent settlement of the structure.



The earthmoving phase ends with the work of adjusting the shape of the road to the planned levels to ensure the drainage of rainwater on the verges. To carry out this work, graders, the basic roadwork equipment, and light tracked bulldozers, in the case of steep slopes, come into play.



## THE ROAD BED

The objective: to ensure the bearing capacity of the upper layer of earthworks which will be used to receive the road layers.

This first layer must have specific qualities to receive the following layers. The materials of which it is composed are selected and their compaction is particularly careful in order to give them a satisfactory bearing capacity :

- During the construction phase by ensuring the movement of machinery and the correct application of materials.
- In the long term to avoid excessive road fatigue.

When the quality of the available cuttings or fill is insufficient, the existing soil is treated by incorporating lime and/or cement. It is also possible to bring in good quality materials, taking care, if necessary, to place a «geotextile» on the soil afin order to avoid pollution of the materials by the fins of the original soil.

## MANUFACTURING OF ROAD MATERIALS

The objective: to prepare the different layers of the road that will form the road base and its surface.

To do this, the manufacturing plants, called asphalt plants, are installed on storage and manufacturing areas where the aggregates are supplied in advance as well as the binders (bitumen; bitumen emulsion or cement).

- Bituminous bound aggregates, road base asphalt and asphalt concrete are manufactured in asphalt plants, where the aggregates are also heated and dried.
- Materials treated with hydraulic binders are manufactured in cold mixing plants.

## **PAVEMENT LAYING**

The objective: to quickly put the different layers that will make up the track.

At this stage, the right weather conditions are essential. For these operations, the techniques used are as numerous as the types of materials.

The first layers of unbound materials or cement bound aggregates are poured onto the support in a heap, then taken up by a grader which spreads them out and adjusts the layer to the planned thicknesses.

Depending on the expected traffic class, the upper part of the base course can be made of asphalt mix, the material is spread at a temperature of 100 to 165 °C in the hopper of a finisher, a machine that distributes the mix over the desired width by means of an auger, adjusts the thickness and slope of the layer and carries out pre-compaction by means of a vibrating table.

Each base layer is compacted by repeated passes of tyre compactors or vibratory rollers to achieve an optimum specific density.

Next comes the «tack coat», which is spread on the substrate in a very thin film of bitumen emulsion which, after the emulsion has broken, ensures the bonding of the asphalt layers.



The teams then lay the wearing course, which is the most important surface to guarantee the road's serviceability. This will be compacted in the same way as the base courses.

In contact with vehicle tyres and subject to climatic agents, the wearing course must have numerous properties, be adherent, flat, impermeable, limit noise and water splashes, reduce consumption and wear of vehicles or avoid dazzle.

## ROAD EQUIPMENT

The aim is to contribute to the safety and smooth flow of traffic on the roads and streets.

This is the final phase of road construction. By alerting, warning and informing, road and street furniture contributes to the safety of all users: motorists and motorcyclists, but also cyclists and pedestrians. Restraint systems, horizontal and vertical signs, traffic regulation equipment, worksite markings and street furniture all play a practical role in improving road safety and the mobility of all citizens.



## **USEFUL INFORMATION**

## TRAINING TWO MOOCS (Massive Online Open Course)

### **ACCEPTABILITY OF URBAN CONSTRUCTION SITES**

The MOOC «FURET acceptability of urban construction sites» is available, free of charge, on the FUN platform. It aims to master the operational levers of action to remove the contradiction between societal demand for the developments and services



of a sustainable city and the acceptability of the building sites necessary for these transformations Jean-Pierre Christory

> = : routesdefrance.com Q Furet

## **MAIRIE 2000** MUNICIPAL ROAD MANAGEMENT

To improve knowledge of the status of roads in the municipal domain and the rules governing them for both users and managers.

- 5 modules :
- Public roads

- Private roads

- Management and maintenance
- Development of the road system

- Roads and inter-municipality

https://moocmairie2000.fr/moodle/

## INTEGRATION OF ENVIRONMENTAL CRITERIA



To integrate envi- • The public procurement reform, which ronmental criteria into public road works contracts, local authority purchasers have a complete legal and technical framework at their disposal: LEGAL:

law n°2015-992 of 17 August 2015 on the

• Ordinance No. 2015-899 of 23 July 2015

on public procurement emphasises the

objectives of sustainable development

energy transition for green growth

came into force on 1 April 2016. Decree n°2016-360 of 25 March 2016 on public procurement takes into account life cycle costs and environmental performance as award criteria **TECHNICAL:** 

• The guide «Public procurement, a response to climate issues» published by the Ministry of Finance and ADEME in October 2016

• The application guide «Environmental acceptability of waste from the deconstruction of public works» published in March 2016 by Cérema

• The SEVE eco-comparator in line with the fundamental principles of public procurement

: routesdefrance.com Q seve www.seve-tp.com

## **USEFUL INFORMATION**

## THE GLOBAL PERFORMANCE CONTRACT

## The implementation of a global performance contract

is aimed at local authorities so that they can entrust a company (or a group of companies) with the upgrading and then the maintenance of all or part of their road and highway network, over a contractual period of 5 to 7 years.

This new public procurement tool, which is in addition to traditional works contracts (mainly purchase order contracts), should enable them to better optimise the financial and human resources allocated to the management of their networks with a dual approach to heritage and services.



This tool can be used by a category of local authorities with a minimum of internal resources to ensure the role

of project owner, interface with the companies, control and management of the proper application of the contract.

Of course, this tool is available to any type of project owner: departments, metropolises, communities of communes or agglomerations, communes, including the State

## THE TESTIMONY OF A COMMUNITY



A new type of public contract, it is intended to enable local authorities to manage the maintenance of the road network and urban roads at controlled costs and timescales.

Paul Le Callennec. Chateaugiron (35) : routesdefrance.com Q contrat global

The global contract is above all a financial saving... a global, simple solution... trusting companies with extremely precise specifications



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## **CONTACT DETAILS OF REGIONAL AND TERRITORIAL** DELEGATIONS

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#### Délégation territoriale Rhône-Alpes

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www.routesdefrance.com/region/aura

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#### ROUTES DE FRANCE CENTRE-VAL DE LOIRE

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www.routesdefrance.com/region/centre

#### ROUTES DE FRANCE ÎLE-DE-FRANCE

9, rue de Berri - 75008 PARIS Tél. : 01 47 66 01 23 E-mail : idf@routesdefrance.com

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