Landscape and road legibility

Some ideas for an approach that brings together road safety and landscape
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We would like to thank all those persons who were involved in drafting this document that aims to inform readers about an innovative approach.
# Background

## Principles and concepts

- Some terminology to assist understanding
- The reasons for extending road legibility to the landscape
- The basis of the “landscape and legibility” method and the working hypothesis
- The user’s perception
- Some examples of situations that are legible or not ...

## The procedure for implementing a method that combines landscape and road safety

- Diagnosis of the landscape sequence
- The interpretation units
- The concepts of constraint and comfort in the analysis of the landscape sequence
- Improving legibility and directions for action

## Examples of treatments

## Bibliography
Background

The origin of this document is the report “Recueil d’expériences Paysage et lisibilité – Approches paysage et sécurité routière” (Collected Case Studies Concerning Landscape and Legibility – Landscape and Road Safety Methods) published in July 2003 [1]. It is intended to help all persons involved with the landscape and infrastructure (planning, design, management, maintenance, redesignation, etc.) make use of the case studies presented in the report. It will enable such persons to understand and become familiar with an approach that is centred on legibility. However, on its own it is not enough to permit direct application.

Road safety is a complex topic and the methodology described here adds another dimension to it: the landscape. The landscape, which is often modified on road safety grounds (removal of vegetation, demolition of buildings, etc.), can also be created, assembled and conserved for road safety needs.

At the start of research into the association between landscape and safety, a working group was set up at the Sétra in order to respond to growing demands for landscape to be considered in road safety methods and vice-versa. Needs in this area had been expressed during

Here are two successive sections (between roundabouts), on the same two-way road. In one case, the hard shoulder is the same colour as the carriageway and in the other it has been coloured differently. In addition, the general environment highlights the differences between the treatment of the two sections. The lack of consistency between the different sections can interfere with the user’s perception of the route.

Source : Jean Charousset - Dot 85

In this urban scene, the alignment of the trees emphasizes the direction of the opposing carriageway – Source : Patrick Savignos and Dominique Guy (CETE Normandie-Centre)

Even if there is a loss of alignment, the tree tops show that the road continues in a straight line – Source : Sophie Noiret (CETE de l’Est)
the redesignation of routes for road safety reasons and with regard to the management of alignment trees. This working group – which consisted of professionals from the areas of landscape, planning and road safety drawn from the Setra, CETEs (Regional Infrastructure Engineering Offices) and DDEs (Département Infrastructure Directorates) - was formed to take stock of the state-of-the-art with regard to road legibility and to disseminate the first methodological findings in three case studies on which some members of the group had worked.

At the end of 2003, the RIPL (Redesignation of routes, road landscape and legibility) working group planned to achieve the following objectives:

• to raise awareness among managers, designers and planners of the need for a multidisciplinary approach;
• to share with these persons their experience and initial findings with regard to road legibility and the understanding of user behaviour;
• to develop methodological tools to aid with decision making and the planning of improvements.
Principles and concepts

Some terminology to assist understanding

Landscape

Landscape is defined in the European landscape convention as “an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.”

Road landscape

(Implicitly, from the user’s point of view, in this document we shall never discuss road landscape as perceived by residents who see the road from the outside. However, this point of view must be taken into account in any infrastructure project.)

This consists of the “ribbon” of the road and the road equipment (horizontal and vertical signing, safety barriers, grass verge or hard shoulder, ditches, slopes, plantations of various types, etc.) as seen from the road. It is difficult to dissociate the road landscape from its immediate environment; the ability of road users to perceive all parts of it simultaneously depends on their level of vigilance.

Visibility

This is a question of “seeing” in the sense of the functional ability to see the road ribbon, intersections, signing and other users without them being masked by obstacles.

“Does the visual information reach users and if it does, does it do so in time (in view of the speeds of the user in question and of the other users) for them to change their behaviour or perform a manoeuvre in response to events?” Extract from reference [2].

Legibility

This is a question of “seeing” in the sense of interpretation: understanding what one sees or what one has just seen, in order to modify one’s driving actions according to the situation(s) encountered, on the basis of pre-existing frameworks of understanding (collective mental references).

“Can the infrastructure and its environment be easily decoded in order to enable users to identify rapidly the location, the path that they should follow and easily anticipate the events (movements of traffic, pedestrians, etc., changes of infrastructure, etc.) which they may be faced with, in order to be able to modify their behaviour accordingly?” Extract from reference [2].

Primary safety

This involves limiting the frequency of accidents by targeting their cause, for example altering user behaviour. The landscape and legibility approach is concerned with this.

Secondary safety

This involves limiting the severity of accidents by targeting the consequences of a loss of control of the vehicle.
The reasons for extending road legibility to the landscape

Improving road safety has a cross-cutting aspect which applies in any studies that relate to the upgrading and design of roads and streets.

This cross-cutting aspect encourages exchange and partnership between different professional circles: this document presents techniques for analyzing the road/street and its environment which will generate a single interprofessional approach for tackling road safety and the landscape (urban or rural) for a route.

This approach favours professional practices which consider the road in its site, which bring together road safety, road design, regional planning and town planning services, as well as contributions from sociologists, landscape professionals, etc. First of all, the aim is to reveal the links and contradictions between all the concerns in order to better understand and conciliate these concerns.

The techniques presented are to a large extent based on methods that were originally developed to tackle the complexity of the urban environment. As the analysis they provided in urban areas proved to be of value, we shall attempt here to extend it to the open countryside, because safer driving practices can also be extended to the interurban context. The road should not be considered as being independent of the environment it passes through, the road improvement strategy has much in common with the overall project design process (road + surrounding land) and operates at route level, with the addition of a dynamic analysis.

It is undeniable that a landscape exists around all infrastructure. What we are interested in is its impact on the act of driving and road safety. To examine this, it is necessary to consider the perception mechanisms when analyzing the route. The environment “reading” influences the driver’s behaviour. As a wrong interpretation may cause accidents, modifying the road environment should improve its legibility. The landscaped improvements bring a long term action. On their own, they are not sufficient to get rid of all the accidents, but they contribute to road safety. Therefore the landscape is an aspect to take into account among many others.

Our work considered existing roads (particularly two-way roads) under conditions of normal (unimpaired) visibility. The approach can also improve understanding of the road-driver-environment interaction which is helpful for the design of the new infrastructure. This road legibility approach does not replace more conventional road safety methods, as SURE (Safety of Users on Existing Roads). It is currently undergoing evaluation and serves to supplement and enrich road safety diagnoses, making it possible to identify sections of a route that are potentially dangerous or perceived as such by taking better account of aspects that relate to the user and user behaviour. In this line, it represents a perfect complement to SURE which analyses in its comprehensive phase of a route the accidents in a qualitative way but also the sections which can potentially cause accidents. This method is never used on its own, and invariably provides a new point of view whether with regard to road safety or land planning, which enables to reveal contradictions between these concerns.
The basis of the “landscape and legibility” method and the working hypothesis

This is a systematic method which involves a consideration of the legibility of the road and its environment, legibility being one of the criteria for assessing the safety of a road [2].

The starting point for research was the idea that the environment, of which the landscape and the road landscape are a part, accompanies the user in his/her driving task. The underlying hypothesis is that drivers adjust their behaviour (speed and rule acceptance) on the basis of constant analysis of the linear data (the dynamic of movement) and the transverse data (probability, perceived or not, of being faced with an event coming from the side) which they collect in the different landscape sections they encounter. A wrong interpretation may cause accidents. By modifying the legibility of the road, the road landscape and the landscape help to guide the user and achieve equilibrium in the human/vehicle/environment system. However one must keep in mind that working on landscape is a long term action which is not sufficient on its own to get rid of all the accidents.

The objective is for the user’s behaviour to be appropriate for the route in question. As this behaviour is directly linked to the driver’s perception of this route, it is therefore essential to attempt to make the road more legible, in order to change the user’s behaviour in a way that improves road safety.

It should be noted that road users modify the way they drive not only on the basis of what they see, but also on the basis of collective or individual mental references which form “the driver’s store of knowledge and attitudes”.

The environment (the road and the road landscape) provides the driver with information about the characteristics of the road and the difficult points on it.

The user then adapts his/her behaviour (speed, vigilance) when approaching an intersection or a bend, or when crossing villages

Source : from “Integrated road safety programs”, OCDE, 1984
The user's perception

The mechanisms

Activities function at three levels which respectively involve:
• automatic reflexes or activities based on skills or habits;
• procedures or activities based on rules;
• problem solving or activities based on knowledge moving from the lowest to the highest level of vigilance/consciousness.

The diagram opposite shows that in 74% of cases there were driver failures in information collection and the analysis of the situation, and therefore in its perception by the user.

The landscape method would seem to be appropriate for improving road legibility as it helps to achieve:
• a better understanding of information gathering;
• a better analysis and description of the road space;
• better information gathering by the user.

The mental activities associated with driving — Source: from Neboit and Blanchard (1978)

Breakdown of human error in personal injury accidents — Source: from INRETS report n° 218, June 1997, "scénarios-types de production de l'erreur humaine dans l'accident de la route"
**Road perception cues:**

**Formal cues:**
- horizontal and vertical signing;
- other road equipment.

**Informal cues:**
- the treatment of roadsides and the surrounding landscape (static cues);
- the instantaneous occupation of the ground, pedestrians, agricultural or forestry activities (dynamic cues).

*Source: Patrick Saingenest and Dominique Guy (CETE Normandie-Centre)*

*Source: Frédéric Gautier (CETE de l’Ouest)*

*Source: Alain Guglielmetti (CETE Méditerrannée)*
In this case it is difficult to determine the type of road. Is it a two-lane road or a four-lane dual carriageway? The treatment of the surroundings and the bridge are typical of motorways, but this road is in fact a two-lane single carriageway.

In this road configuration, the user experiences poor visibility and poor legibility of the bend and the intersection. What the user sees (a double line of trees) contradicts the signing. The user will wonder where the road is going and where the intersection and the bend are.

Here the visibility and legibility of the bend are good. This bend is clearly visible, as is the road. The slope, the vegetation and the house highlight the existence of a bend and its direction.

The road is legible when its configuration matches the type of practice expected by the driver.
The procedure for implementing a method that combines landscape and road safety

Diagnosis of the landscape sequence

Establishing the landscape sequence along the route, which is performed for each direction of traffic, aims to represent what the driver sees for suitable improvements to be designed.

This dynamic sequence (see below) links each of the components of the route to each other. Thus, by superimposing different criteria, the points where problems occur will be identified. Such points consist of places where the landscape either fails to improve road safety or reduces it, because it causes drivers to adopt behaviour which is the opposite of that which one would expect of them. These are the points where the legibility of the road should be improved first.

The objective is to arrive at a succession of landscape sections where no conflict remains between the user’s knowledge and references and the road configuration.

The construction of the sequence depends on four types of criterion:

1. The technical configuration of the route:
   • road geometry;
   • design principles (status of the route, priority rules, grade separation, intersection design, etc.);
   • road equipment.

2. The functional aspect:
   • the nature of the traffic;
   • the types of user;
   • uses and functions.

3. The surrounding land and landscape:
   • topography;
   • roads and visual boundaries;
   • land use;
   • the landscape units (large landscapes);
   • the precepts of overall landscape design and any localized improvements;
   • atmosphere (daytime, night-time).

4. The user’s perception:
   • the concepts of constraint/comfort;
   • the dynamic interpretation of a route (UPI/UPVC, see following pages).

The first three groups of criteria provide the technical sequence of the route. Problems are revealed when we compare this to a sequence which is based on the user’s interpretation of the road, derived from the last group of criteria.

The combination of this dynamic sequence of a route with user behaviour supplements and enriches the road safety diagnosis. When conducted simultaneously and placed side by side, these two approaches improve our ability to characterize and understand the problem zones.
This dynamic sequence is above all linked to the landscape units which are determined with reference to the large landscape scale: the journey is divided up on the basis of the landscape units that are crossed. The sequence is also established from analysis at three smaller scales.

The landscape scales are as follows:
• the kilometric scale: general geographical atmosphere as large landscape groups which structure the travelled road and the distant views (valley, hill, bocage, vineyard, etc.);
• monuments: a break in the monotony represented by landmarks such as spire, silo, etc.;
• the hectometric scale: overall legibility which lays on close landscapes;
• the driving scale: close visibility and legibility found on the road and the road reservation.
The interpretation units

The driver visual perception unit (UPVC):
- this is a homogeneous whole perceived by the travelling driver (the driver’s total visual field);
- it includes the overall legibility and monuments (road, road environment, hectometric scale lateral spaces, the moderately wide frontal horizon);
- it provides a rhythm to the journey.

The infrastructure perception unit (UPI):
- this is the unit the driver sees when driving (it is where the driver obtains the information needed for driving);
- it corresponds to close visibility and legibility (road ribbon / bends / road markings, lateral spaces: verges/vertical signing/plantations, with the road horizon as the focal point);
- it allows the driver to anticipate in the short term (acceleration, deceleration, braking) and involves the direct road-driver interaction.

Examples of UPVC cut by a route — Source: Dominique Guy (Cité Normandie-Centre)
The UPI is a space within which the user moves along the axis of the road. In this dynamic situation, analysis can use the two following concepts: moving along within the UPI and doubling of the UPI.

**Moving along within the UPI**

The horizon moves at the same time as the vehicle. This creates a pipe effect:
- speed remains constant or increases (to be checked in the field);
- attention is less sustained;
- if the UPI ends suddenly there is a new landscape section which may be preceded by deceleration or even a stop.

If the UPI ends with an “unexpected” event: a bend or an intersection, there is a danger of being surprised, depending on the curvature of the bend or the close visibility of the intersection.

What should be done: emphasize and mark lateral events, cut off the IPU, work on the transitions between UPIs, artificially mark, open up or close off UPIs with plantations or design features, etc.

Note: the UPI is contained within the UPVC.

Source : Dominique Guy (CETE Normandie Centre)

Source : Dominique Guy and Michel Bouvier (CETE Normandie Centre)
Doubling of the UPI

- When travelling in an UPI, another UPI can be seen in the background which extends the zone of perception. This may be caused by a bend or a slope. In this case, the two UPIs are separated by a mask of varying length. Alternatively, it may considered that it is the same IPU with a mask in it.
- In this case, perception may be confused.
- The driver may anticipate an event, leading him/her to maintain the same speed, accelerate or decelerate suddenly.
- This may lead to offending behaviours on the part of drivers who may attempt to estimate the speeds and frequencies of vehicles in order to overtake in zones where this is prohibited or where visibility is limited.

What should be done: depending on the configuration, open up or close off the extension of the UPI (planting or felling of trees), avoid the installation of activities or give them enough importance to create two UPIs with a clear break between them, etc.

Source: Dominique Guy and Michel Bouvier (CITE Normandie-Centre)
The concepts of constraint and comfort in the analysis of the landscape sequence

While the earlier analysis of landscape at different scales expresses the transverse situation, the concept of constraint/comfort is more related to the linear situation with regard to the dynamics and rhythm of the journey. Today, it is widely recognized that driving requires a high degree of vigilance on the part of the driver.

The objective of “constraint/comfort” analysis is to adjust the level of vigilance by modifying the driver’s workload and attentional process on the journey. Breaks in monotony, whose ability to increase vigilance requires no further demonstration, should play a role in the construction of a rhythm which conforms with expectations.

The words “constraint” and “comfort” are related the sensation the driver may feel when going through the different units of the route. To simplify, these concepts of constraint and comfort highlight the driver’s driving strategy:

• the concept of “constraint”: this is the real or perceived interference, caused by rules, dense traffic, a difficult road alignment or specific features of the infrastructure which the driver must either adapt to or be exposed to excessive risk;
• the concept of “comfort”: this is the well-being provided by a broad perception of the road environment which provides the driver with the freedom to increase speed to a certain extent, while complying with the driving rules.

The different types of landscape section are as follows:

• Constrained urban section:
  - the environment is more or less densely urbanized over a significant length: the buildings may be immediately adjacent to the road or not;
  - the presence of several complex intersections relatively close together (< 1000 m);
  - the localized presence of equipment or road design with a strong urban connotation: street lighting, advertising, treatment of roadsides, etc. ...

Together these elements inform drivers that they are in a zone where there is a high potential for conflicts.

• Constrained rural section:
  - a closed landscape providing practically no lateral vision;
  - the absence of a distant perspective view;
  - difficulties in road layout: bends, slopes, loss of alignment, intersections, etc.

Under normal driving conditions this configuration makes anticipation difficult and means that driving is dependent on how other motorists drive. But, from the management point of view, it permits to control the drivers’ speed.

• Comfortable rural section:
  - an open, clear, landscape providing distant lateral views;
  - distant perspective views in the line of the road;
  - straight roads with wide bends with a relatively flat longitudinal profile.

This configuration provides large margins of safety and initiative with regard to the rest of the traffic, which is not always appropriate for road safety.
The connection between these notions and road safety in not so simple nor categorical. It depends on the site configurations (about the units themselves or the sequence of units). A section felt “comfortable” by the driver may be unsafe, as a section felt “constrained” can contribute to improve road safety, and vice-versa.

In a long sequence of constrained units, the driver can feel a kind of pressure and will try go get free at any opportunity (for instance when a driver is jammed behind a truck or a farm tractor driving under the speed limit). In a long sequence of comfortable units, the driver may lose one’s attention and become less vigilant close to a bend or a crossing (for example on a road which is straight for several kilometres and where there is a bend in a loss of alignment).

The most important in this approach is to understand what the driver can feel on the route in order to take it into account in the establishment of a travel rhythm and in the road improvement.

When constructing the rhythm, the attempt should be made to identify and emphasize the important locations where monotony is broken (landscape section boundary), and to take account of the length of the landscape section in order to avoid the effects of image persistence and the sequence of landscape sections on driving behaviour. The ideal rhythm would consist in a cycle: alternation of constrained sections with comfortable ones.
Improving legibility and directions for action

The analysis presented here allows us to understand the problems and act on different areas of space:
• the road ribbon;
• roadside vegetation;
• the landscape in general, i.e. everything which is outside the road reservation.

It can also encourage thought about travel practices.

Intervention beyond the road reservation

The use of town planning documents (local development plans – PLU, zone consistency plans (SCoT), landscape plans, etc.) in safety methods is recent (2 or 3 years). It supplements and corrects certain actions which were focused on the road as such and which were either ineffective in the long term or led to the creation or displacement of problems.

Work on safety at the large landscape scale and the use of planning documents is a long term addition to infrastructure improvement actions, as imagined in SURE approach. The dynamic landscape sequence along a route reveals the different uses and functions of the road and its environment.

When combined with planning considerations, this sequential analysis provides a way of taking account of road safety concerns including, in particular, that which is covered by this document: the legibility of the route and its surroundings. The proposed improvements to the road and land use will take better account of road safety which will help to make these proposals relevant for a longer duration.

In both urban and rural areas, it is essential to consider future land use when a route is analyzed in order to take account of planned changes such as the creation of an enterprise estate or a housing estate for which access must be provided, etc. This permits road improvements, transformation into a four-lane dual carriageway or the creation of an overtaking zone or a by-pass, which are compatible with current and future land use and which will improve road safety in the future.

The margins of manoeuvre which exist in order to manage effectively the interrelationships between the road and the large landscape in the medium and long term are provided by the urban planning documents (PLU, SCoT). The sequential analysis of a route and the road safety diagnosis are therefore capable of stimulating fresh planning ideas. Vice-versa, planning studies can be enriched by road safety considerations, in particular the legibility approach.

The planning instruments (PLU, SCoT,...) contain decisions which will have an impact at the large landscape scale as they express ideas about the future land use. Some examples are:
• marking an ambience by restricting land use to enterprise or housing;
• marking an ambience by classifying the land as non-residential vacant land;
• modifying long-term visibility and legibility by deciding to build lower or higher buildings, by positioning them near or far from the road, by deciding on the density of construction, etc.;
• by encouraging building on both sides of the road on some land and on just one side of the road on other land;
• regulating land use at some rural intersections in order to make perpendicular roads visible and thus improve transverse visibility on a rural route;
• establishing a classification of farm access roads that will enable some to be closed;
• planning an increase in forested areas and the replanting of hedges in order to close off excessively distant views which hide a loss of profile or false plateaux;
• etc.
Examples of treatments

The “before/after” cases presented in the following pages should not be considered as solutions that can be systematically applied at all locations and in all situations. The primary aim is to show a few localized planning concepts that have their origin in comprehensive route level studies based on the legibility of the road and the landscape.

Marking a bend by an alignment of trees on the outside or a hedge to assist anticipation — Source: Jessica Brouard (Sétra)

Perception of a double UPI

Cutting down the trees of the edge of the first UPI and planting a hedge that masks the second UPI to ensure the user slows when approaching the bend — Source: Dominique Guy (CETE Normandie-Centre)

Note:
Three route studies are presented in the Collected Case Studies Concerning Landscape and Legibility [1].

Note:
The trees are planted at the top of the embankment as regard to planting rules (distance between trees and the edge of the roadway).
A very wide road passing through a village

Danger that motorists on the trunk road will be dazzled by those on the minor road

Avoid dazzling by planting a hedge or a copse

Source: Dominique Guy (CSU Normandie-Centre)

Redesignation of space — Source: Frédéric Carlier (D26 62)
Marking a change in gradients by an alignment of trees that makes the road more visible — Source: Dominique Goy (Cère Normandie-Centre)

Before

After

Emphasizing an intersection with a line of trees in order to warn drivers — Source: Jessica Brouard (Sitra)

Note:
The tree must be planted in regard to planting rules (distance between trees and the edge of the roadway) and crossing roads visibility rules.
A four-lane dual carriageway which is inappropriate for a cross-town link…

…redesignated as an urban road – Source: Valérie Normand (DREAL)

Four-lane dual carriageway constructed in phases with definitive treatment of the road sides.

Planting of the non-constructed carriageway in order to reduce the visual field – Source: Jean-Louis Chevalier (CETE de l'Ouest)

Working on the redesignation of the carriageway and the urban furnishings enables to emphasize the urban characteristic of the passage through this town – Source: Frédéric Gautier and André De Neuville (CETE de l'Ouest)
Bibliography


Following the publication in 2003 of a report collecting case studies dealing with «Road landscape and legibility», Sétra went thoroughly into this topic in order to create a methodological approach, bringing together road landscape, legibility and safety. This was done within the framework of the seminar «Road otherwise», which was organized by the General Road Directorate and where the problematic of the alteration of road design and equipment principles was tackled in order to change the user’s behaviour in a way that improves road safety.

This document doesn’t intend to be a methodological guide, but it briefly highlights the main principles of an approach which brings together road landscape and safety through road legibility and which is based on the user’s perception of road. This approach comes from the transposition of urban practises in interurban areas, which have been proved to be efficient for more than twenty years. It represents additional information regarding traditional road safety approaches, such as SURE (User Safety on the Existing Road Network), bringing new ideas which link together as much as possible infrastructure to the area which is served by the infrastructure.