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# Evaluation of three-dimensional pedestrian crossing trials

## Summary

Study Report, 15 February 2021


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**Partners**

*Delegation for Road Safety,*

SÉCURITÉ ROUTIÈRE
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*General Directorate for Infrastructure, Transport and the Sea,*
*The intercommunal cooperation authorities (EPCI) and local authorities that produced the most documented assessments include: Bordeaux Métropole, Bourgoin-Jallieu, Clermont Auvergne Métropole, Métropole du Grand-Nancy, Nantes Métropole, Métropole Rouen*

## Keywords

**Keywords according to thesaurus**
Pedestrian crossings, regulations, trials



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It was written by Valérie Battaglia and Benoît Hiron from Cerema, under the direction of Benoît Hiron and Daniel Lemoine from Cerema Territoires et Ville.

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## Disclaimer

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# Summary and recommendations

A number of publicity campaigns presenting the three-dimensional pedestrian crossing as a spectacular and innovative solution for improved pedestrian crossing compliance were successfully undertaken in a number of countries from early 2017 onwards. Some French municipalities, unfamiliar with the regulations governing signs and marking in France, took the plunge and installed these 3D crossings, which were offered in catalogues.

Noting the enthusiasm generated, the Delegation for Road Safety decided to support the process by offering a simplified experimental approach based on the principle of notification. This wave of trials set out to establish a national doctrine for the installation of these 3D pedestrian crossings and to decide whether or not this type of crossing should be included in the regulations.

An order was issued on 29 June 2018 in this regard, specifying the installation requirements, the need for an appraisal prior to implementation, at midterm and then at the end of the term, as well as the main data to be collected.

At the same time, Cerema proposed a more comprehensive set of evaluation specifications for local authorities or intercommunal cooperation authorities (EPCIs) that were willing to apply them.

Of the 82 notifications submitted to the Delegation for Road Safety, few ran the trial until the end of the planned period. Indeed, many cities soon realized that the 3D effect that was supposed to alert drivers was not in fact as spectacular as it appeared in the advertisements. In addition, they quickly ran into maintenance problems.

In short, few trials were completed and few reports were submitted to the Delegation for Road Safety.

However, six metropolises and municipalities conducted an evaluation in partnership with Cerema, based on speed measurements, behavioural observations and feedback questionnaires, comparing the situations prior to implementation, during implementation and after consolidation (six months). Bourgoin-Jallieu, as well as the metropolises of Bordeaux, Clermont-Ferrand, Nantes, Nancy and Rouen therefore made it possible to construct a common doctrine by objectifying feedback.

The main findings are as follows:

- Although an effect on driving speeds can be determined at the time of implementation, it is very limited and disappears within six months, reverting to the previous situation;
- There are many situations (light levels, rain, night time, type of users) in which the 3D effect is not perceptible; Indeed, the 3D effect is only visible at quite a specific distance from the pedestrian crossing, and is therefore very fleeting for drivers, especially drivers of high seated vehicles (HGV) who do not see the 3D effect;
- The cost is significantly higher than that of a conventional pedestrian crossing, in the region of five to ten times higher;
- Maintenance is far more intensive (with repainting being required every six months instead of every two-and-a-half years).

All these results lead us to recommend against the inclusion of this type of 3D pedestrian crossing in French regulations and thus to remain in conformity with the Vienna Convention on Road Signs and Signals, which we share with our neighbours in Europe.

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# 1 Introduction

Inspired by the urban or street art that has appeared in a number of countries, striking pictures of pedestrian crossings with an optical illusion effect for drivers (creating the impression of the existence of a three-dimensional object) became common on the Internet but they lacked any evaluative component.

Horizontal road sign and marking companies decided to offer this type of marking with this intended effect. The aim was to use the surprise effect to slow drivers down in order to improve consideration of pedestrians wishing to use pedestrian crossings to cross the road.

The idea of using an optical illusion is thought to have first appeared in India followed by Iceland, where it received media coverage. A number of municipalities implemented them from the summer of 2017 onwards, illegally. In fact, this type of pedestrian crossing marking is not included in the regulatory framework of the Order of 24 November 1967, as amended, concerning signs and marking for roads and motorways. It is therefore not covered by the Inter-ministerial Instruction on Road Signs and Marking (IISR). Neither is it provided for in the 1968 Vienna Convention on Road Signs and Signals.

While the three-dimensional pedestrian crossing (French acronym: PP3D) appears attractive at first, it is much more expensive than conventional pedestrian crossings and its effectiveness had not been evaluated.

Given number of local authorities interested in using this type of marking, the Road Safety Delegation set out to provide a framework for the numerous trials in the form of a single, simplified procedure with which to evaluate its pertinence. An order was issued on 19 June 2018 (*See* Appendix 1), describing *as a minimum* a specific area of use and limiting the administrative steps to simple notification by local authorities to the Delegation for Road Safety, as well as a commitment to provide an interim evaluation report by 31 December 2018, and a final report by 31 December 2020.

For its part, Cerema drew up simplified specifications to facilitate this evaluation (traffic measurements, minimum speeds, qualitative user feedback, etc.) and to provide uniformity throughout the national territory. At the same time, information was provided on best practice for trialling a three-dimensional pedestrian crossing[1].

In 2018, the Delegation for Road Safety received 38 applications, two of which were turned down because they did not meet the criteria of the order. 46 were submitted in 2019 (*See* Appendix 2).

In the end, the Delegation for Road Safety received 26 interim and 18 end-of-trial reports. The quality of these ranged from thorough assessments to simple summary e-mails.

Some of the municipalities removed their 3D pedestrian crossings (PP3D) a few weeks after installing them, others did not maintain them and they soon faded. These 3D pedestrian crossings were not properly evaluated.

The Delegation for Road Safety entrusted Cerema with drafting a summary of the evaluation reports that were sent to it.

Six of these reports were produced by Cerema on behalf of local authorities. These are the most well-documented reports, for which the methodology used facilitates the objectification of feedback through physical measurements, in particular as regards speed measurement, observation of uses and user questionnaires before/after installation and a few months later.

[1] *https://www.cerema.fr/fr/actualites/installer-passage-pietons-trois-dimensions-pp3d*

# 2 Presentation of the three-dimensional pedestrian crossing

## 2.1 Stated objective

The stated purpose of this type of crossing is to improve pedestrian safety at crossings not equipped with light signals. The aim is to use the 3D effect to raise driver awareness of pedestrian crossings and therefore ensure greater consideration of them.

## 2.2 Principle

The “3D” effect is based on the principle of anamorphic projection.

Anamorphosis is **a distorted projection requiring the viewer to use a special** device **or occupy a specific vantage point in order to be seen correctly. It creates the impression of perspective in a flat image**. This technique is used by artists and also in advertising in stadiums for television broadcasts; advertisements, which are often painted on the grass, are difficult for people on site to read but clear to viewers.

Currently, blocks of grey and black paint are added around the regulatory stripes of the pedestrian crossings, creating a volumising effect, if one is positioned at the right viewing angle.

The result gives the impression of parallelepipeds lying on or floating above the road surface.

*Example of a 3D pedestrian crossing (PP3D)*

## 2.3 A priori analysis

By principle, the 3D effect created by anamorphic projection can only be seen from one position and viewing angle. On the one hand, a driver (at 50 km/h, a vehicle travels at 14m per second) will only see this effect for a very short time; on the other hand, the driver's position, depending on the vehicle's size and its position on the road, differs in height and width (motorcycle, passenger vehicle, HGV, etc.), which has an impact on perception of the 3D effect.


*Location of a point at which the 3D optical illusion can be viewed and photographed.*

In addition, perception of the 3D effect is linked to perception of the marking and, in particular, perception of the shades of grey.

Variations in lighting conditions (light levels, angle of the sun's rays), shadows cast (by buildings or vegetation), changes in the colour of the crossing markings over time (ageing of the material, dirt, rainwater) and the colour of the road surface and its ageing can all interfere with the visibility of the 3D effect.

*Anamorphosis of François Abelanet in Paris Hotel de Ville*
*Source: https://www.talentsdici.com/blogue/lanamorphose*

## 2.4 Availability on the market

Some companies decided to include 3D pedestrian crossings in their catalogues, regardless of their continued illegality and without warnings for those unaware of this fact.

The rates are given for supply and installation.

Three-dimensional pedestrian crossings are made either from heat-sealed strips or cold resin laid on the road surface, reproducing the anamorphic pattern. For these two materials, the layout plan for application of the strips or the dimensions of the shapes to be made with the resin are provided by the vendor according to the width of the street. The other solution is to create the shapes in three-tone marking products: white and shades of grey.

The cost is very low if it is carried out by the local authority, a few hundred euros (in the case of Bourgoin-Jallieu). However, it needs to be redone frequently (every six months as opposed to every two-and-a-half years in the case of a conventional pedestrian crossing).

If this type of crossing is installed by the manufacturer, the cost is in the range of €2,000 to €6,000. It depends on the length of the crossing.

Note that a conventional pedestrian crossing would cost €250 to €510 (six or seven three-meter strips).

*Example of a new 3D pedestrian crossing*

## 2.5 Complex installation

Even more than in the case of a conventional pedestrian crossing, the installation of a 3D pedestrian crossing requires personnel to be trained. This was a new type of crossing, which may explain several reports of errors in sizing, orientation and installation that subsequently required corrective action. Moreover, creating the colour gradations takes longer than it does to produce a conventional pedestrian crossing.

In addition, while installation of a conventional pedestrian crossing is generally a well-mastered procedure and produces the roughness coefficient required by law for a new pedestrian crossing, this concern seems to be absent for the different shades of grey. Remember that the paints used are not approved for use on roadways.

It is important to bear in mind that roughness requirements contribute to accident prevention. In fact, their purpose is to limit the risks of skidding in wet weather, particularly in the case of motorised two-wheel vehicles with poor grip surfaces.

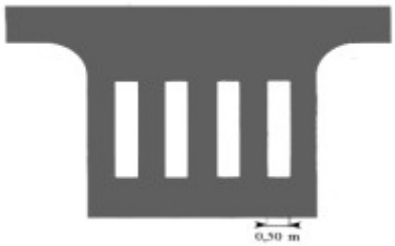
# 3 Regulatory Framework

## 3.1 Regulatory definition of a pedestrian crossing

Article R.412-37 of the French Highway Code requires a pedestrian "crossing" to be used where one exists within a distance of 50 meters.

As per article R.411-25, the latter is defined in the aforementioned order of 1967. Its area of use, which is enforceable against road managers, is defined in Article 118 of the Interministerial Instruction on Road Signs and Marking (IISR). French regulations have only one type of pedestrian crossing. The 3D pedestrian crossing (PP3D) is considered to be a second type, so a trial phase

needs to be run to verify its effectiveness.




*Regulatory Marking, Article 118 of the Interministerial Instruction on Road Signs and Marking (IISR).*

This marking must be made with approved materials as defined in Article 5 of the Interministerial Instruction on Road Signs and Marking (IISR).[2].

In addition, in application of the order[3] of 15 January 2007 concerning the accessibility of the roadway, a pedestrian crossing must be visually contrasted with the roadway. The crossing must also incorporate a guidance system, the purpose of which is to help people know where they are on pedestrian crossings and detect their boundaries. This system can be a tactile contrast applied to the roadway or the afore-mentioned marking, or any other equally effective system.

## 3.2 Framework for trialling 3D pedestrian crossings

The IISR is mandatory and any systems not included therein are not allowed on roads open to public traffic.

However, experimental sign and marking trials may be run, with the agreement and under the supervision of the Delegation for Road Safety and the Directorate General for Infrastructure, Transport and the Sea (DGITM), pursuant to Article 14-1 of the IISR4.

In this context, these two departments issued an order on 29 June 2018, authorising the trialling of these 3D pedestrian crossings.

This order:

- specifies the requirements for the installation of the crossings (location and materials used) and calls for the performance of an evaluation including a number of elements to be provided, as well as the duration of the trial, *See* Appendix 1 - Trial Order;
- provides for a procedure that consisted in the submission, by the road manager, of advance notification before 31 December 2018, for a possible trial until 1 April 2020[5].

Local authorities therefore have some freedom in the installation of their 3D crossing system, the major constraint being to create a relief effect with a lawful pedestrian crossing.

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[2] *For example, a minimum roughness is required (SRT coefficient of 0.45 to nine) to prevent skidding, particularly in the case of powered two-wheelers in wet weather.*

[3] *Order applying decree No. 2006-1658 of 21 December 2006 concerning the technical requirements for the accessibility of the roadway and public spaces.*

[4] *The principle of the experiment is provided by the Interministerial Instruction on Road Signs and Marking (IISR). The Delegation for Road Safety authorizes a trial, to be carried out by a road manager, provided that it complies with evaluation specifications and is evaluated. In the event of an accident, the local authority will therefore be "covered" as regards compliance with the regulations in force. The aim is to be able to use the evaluations requested to develop the doctrine and regulations.*

[5] *After this date, the crossings either must be removed or kept if they have been included in the regulations by this date.*

In order to obtain relevant evaluations, Cerema published an article outlining the need to conduct trials and perform a proper evaluation. An evaluation must be conclusive, to be positive, it must demonstrate the value for road safety without secondary effects.

# 4 Summary of the 3D pedestrian crossing evaluations

## *4.1 Evaluations performed*

The following inventory of these evaluations is based on documents collected by the Delegation for Road Safety and Cerema on 30 April 2020.

As per the aforementioned order of 29 June 2018, the trial had to include the items set forth in the table below.

Some evaluations also include a study of user behaviour (not required by the order but recommended by Cerema).

### 4.1.1 Summary table of the documents analysed

| Towns | Nantes metro–politan area | St Etienne de St Geoirs | Saint Amand les eaux | Annemas-se | Grigny | Valence: | Calais | Bordeaux métropole | Bourgoin-Jallieu | Clermont Ferrand | Pulnoy | Cébazat | Métropole Rouen Normandy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nb crossings | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 5 |
| Site ref. | N1, N2, N3 | SE1 | SA1, SA2 | A1 | G1 | V1 | C1, C2 | Bx | B 1, B 2 | CF1 | P1 | CB1 | R1, R2, R3, R4, R5 |
| Type of document provided | Report | Email | report | Email | letter | report | report | report | report | report | report | report | report |
| Description of the installation site | x | no | x | no | x | x | x | x | x | x | x | x | x |
| Descriptions of the main flows | x | no | x | no | no | x | x | x | x | x | x | x | x |
| Type of crossing | x | no | x | no | no | x | x | x | x | x | x | x | x |
| Speed measurement | x | no | no | no | no | x | x | x | x | x | x | x | x |
| Accidents over the last five years | 1 serious accident, pedestrian | no | no | no | no | no | no | x | 1 serious accident, pedestrian | 2 minor accidents, pedestrians | x | x | See inventory below |
| User questionnaire | x | no | no | no | no | no | no | x | x | x | x | x | x |
| Installation and maintenance costs | x | no | x | no | no | x | x | x | x | x | x | x | x |
| Durability of the crossing | x | no | x | no | no | no | no | x | x | x | no | x | x |
| *Driver behaviour* | *x* | *no* | *no* | *no* | *x* | *no* | *no* | *x* | *x* | *no* | *x* | *x* | *no* |
| *Pedestrian behaviour* | *x* | *no* | *no* | *no* | *no* | *no* | *no* | *x* | *x* | *no* | *x* | *x* | *no* |

### 4.1.2 3D pedestrian crossing for which there was no notification or evaluation

A number of local authorities made these 3D markings but made no trial application (either before or after issuance of the afore-mentioned order), *See* 3.2.

In addition, some local authorities did not carry out any evaluation or the results of these were not forwarded to the Delegation for Road Safety. Media monitoring shows that a significant number of 3D pedestrian crossings were installed without any regulatory consideration or monitoring mechanism, which constitutes a legal risk for the legally responsible authority and the road manager in the event of an accident.

It is impossible for us to estimate the number of installations involved.

### 4.1.3 Inventory of sites with evaluated 3D effect marking

The diversity of sites with a 3D-effect pedestrian crossing (number of lanes, speed limit, one-way or two-way street, traffic, etc.) does, however, allow for a representative panel to be obtained.

| Site ref. | Number of lanes and installation | type | Direction with 3D crossing installed | Speed km/h limit | Environment | Flow pedestrian | traffic |
|---|---|---|---|---|---|---|---|
| **V1** | 2 lanes | two-way street | 2 | 30 | Municipal Library | 30 pedestrians/ day | 1,500 veh/day 27bus/d/ direction |
| **C1** | 1 lane | One-way street | 1 | 50 | Tax Center and Health Insurance Fund | ? | 500 to 700 veh/hour |
| **C2** | 2*2 lanes + central reservation | two-way street | ? | 50 | Shopping centre | ? | 11,900 veh/day |
| **SA1** | 2 lanes + speed bump | two-way street | ? | 30 | Nursery and primary schools | ? | 50 veh/hour |
| **SA2** | 3 lanes + speed bump + central reservation | two-way street | ? | 30 | Shops and schools | ? | 1,000 veh/day |
| **CF1** | 2 lanes | One-way street | 1 | 50 | City centre, shops and facilities | Several thousand per week | 2,800 veh/day |
| **B1** | 2 lanes + central island + staggered crossings | two-way street | 2 | 50 | Commercial areas and bus stop 1 serious accident | ? | 7,000 veh/day HGV 7% |
| **B2** | 2 lanes | two-way street | 1 | 50 | Shopping area | ? | 6,000 veh/day HGV 1 to 2% |
| **Bx** | 1 lane + cycle lane | One-way street | | 50 | City centre | 140 pedestrians/ day | 4,900 veh/day HGV 3% |
| **N1** | 2 lanes + parking | two-way street | 1 | 30 | Small collective dwellings 1 serious accident | low | 1,800 veh/day HGV 10% |
| **N2** | 2 lanes + cycle lane + parking + central island link section | two-way street | 2 | 50 | Proximity to school + collective dwellings | 25 pedestrians/ hour | 4,000 veh/day HGV 6 to 8% |
| **N3** | 1 lane + two-way cycling + parking | One-way street | 1 | 30 zone and then shared space | Proximity to school | 30 pedestrians/ hour | 1,200 veh/day HGV 1 to 2% |
| **P1** | 2 lanes | two-way street | 1 | 50 | Proximity to school bus stop housing and shops | 25 pedestrians/ hour | 4,000 veh/day |
| **CB1** | 2 lanes | two-way street | 1 | 50 | City centre city hall + shops | ? | 2,300 veh/day |
| **R1** | 2 lanes + central island | two-way street | 2 | 50 | Commercial area 1 ACC | 350 pedestrians/ day | 6,000 veh/day HGV 6 to 7% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **R2** | 1 lane<br>+ cycle path | One-way street | 1 | 30 | School + public facilities, 1 accident | 475 pedestrians/ day | 1,300 veh/day HGV 0.1% |
| **R3** | 2 lanes | two-way street | 1 | 30 | Schools<br>2 ACC | 110 pedestrians/ day | 1,700 veh/day HGV 5 to 6% |
| **R4** | 2 lanes | two-way street | 2 | 30 | School + public facilities, 1 accident | 730 pedestrians/ day | 3,200 veh/day HGV 2 to 5% |
| **R5** | 2 lanes<br>+ 2 cycle paths<br>+ J11 beacons marking the middle of the road | two-way street | 2 | 30 | School + public facilities | 850 pedestrians/ day | 7,000 veh/day HGV 2 to 3% |

## *4.2 Results of the evaluations collected*

### 4.2.1 Summary table

| Site reference | Type of product | 3D effects visible | Evolution of vehicle speed | Pedestrian and driver behaviour | Questionnaire acceptability, others? | Other problems |
|---|---|---|---|---|---|---|
| **V1** | Heat-sealed strip | / | No significant difference after 3D crossing installation | / | / | / |
| **C1** | Heat-sealed strip | no | No significant difference after 3D crossing installation | No change in driver behaviour because 3D effect not visible | / | / |
| **C2** | Heat-sealed strip | no | / | No change in driver behaviour because 3D effect not visible | / | / |
| **SA1** | Heat-sealed strip | / | / | / | / | Thermogum fades with time |
| **SA2** | Heat-sealed strip | / | / | / | / | Thermogum fades with time |
| **CF1** | Heat-sealed strip | / | No positive effect on speed:<br>- Slight decrease at three months<br>- Speed returned to initial speed at one year<br>- Increase at 18 months | / | Only pedestrians were interviewed.<br>Half of them noticed and identified the 3D effect. For the majority of these pedestrians, there was no change in their behaviour or sense of safety.<br><br>There was no change in behaviour for the majority of pedestrians or drivers.<br>Mixed opinion regarding the 3D crossing | Durability equivalent to "standard" heat-sealed strips |
| **B1** | Paint based on heat-sealed design | Barely noticeable | No effect on speed | Pedestrians crossing more often on the new marking, but the effect did not last over the medium term<br><br>Drivers more respectful of | 3D crossing barely noticed by the users<br><br>Opinion of most pedestrians: no change in driver behaviour. | Paint faded after six months |

| Site reference | Type of product | 3D effects visible | Evolution of vehicle speed | Pedestrian and driver behaviour | Questionnaire acceptability, others? | Other problems |
|---|---|---|---|---|---|---|
| | | | | pedestrian priority, but the effect did not last over the medium term. | No change in the sense of safety.<br><br>Very mixed opinion regarding the 3D crossing | |
| **B2** | Paint based on heat-sealed design | Barely noticeable | No effect on speed or significant differences | Drivers more compliant regarding pedestrian priority but no significant effect in the medium term | 3D crossing barely noticed by the users<br><br>No change in behaviour or sense of safety.<br><br>Mixed opinion regarding the 3D crossing | Paint faded after six months |
| **Bx** | Heat-sealed strip | Barely noticeable | No significant difference after implementation, slight increase after six months (not necessarily related to 3D pedestrian crossing) | Drivers more compliant regarding pedestrian priority but no significant effect in the medium term | Users who were accepting of the 3D crossings<br><br>Users believe that the effect on speed is temporary as drivers get used to the 3D effect. | Cyclists who leave their cycle lane to avoid riding on the 3D pedestrian crossing<br><br>3D effect eliminated when the 3D pedestrian crossing is in the shade<br><br>The marking fades after six months |
| **N1** | Cold resin | Depends on the light level | No change between installation and the medium term | | Few drivers notice the 3D effect and they do not modify their behaviour<br>Mixed opinion regarding the 3D crossing | Good weather-resistance of the colours |
| **N2** | 2 lanes<br>+ cycle lane<br>+ parking<br>+ central | two-way street | 2 | 50 | Proximity to school + collective dwellings | 25 pedestrians/hour |

| Site reference | Type of product | 3D effects visible | Evolution of vehicle speed | Pedestrian and driver behaviour | Questionnaire acceptability, others? | Other problems |
|---|---|---|---|---|---|---|
| | island<br>link section | | | | | |
| **N3** | Paint | Barely noticeable | Impossible to determine because the speed limit has changed | | 3D effect barely noticed by users<br><br>No change in driver behaviour<br><br>Pedestrians: no change in behaviour or sense of safety<br><br>Mixed opinion regarding the 3D crossing | Paint faded after six months |
| **CB1** | Heat-sealed strips | / | No significant changes in speed | No behavioural changes that can be attributed to the 3D effect. | Only pedestrians were interviewed.<br><br>Pedestrians who are also drivers noticed and identified the 3D effect. Half of them say they have reduced their speed but not changed their behaviour towards pedestrians.<br><br>For pedestrians: no change in behaviour or sense of safety, but some say drivers stop more often.<br><br>Mixed opinion regarding the 3D crossing | Durability equivalent to "standard" heat-sealed strips |
| **R1** | Cold resin | Limited perceptibility (short time, weather). | Speed decreases in the direction with no 3D effect and increases in the direction with 3D effect. | / | Pedestrians: increased sense of safety and crossing more pleasant and less congested. | Wheel marks: need for regular refreshing of the marking. |
| **R2** | Cold resin | Limited perceptibility (short time, weather). | Increase in speed due to the removal of the speed cushion when the 3D effect is installed. | / | Pedestrians: no change in users' opinion before/after installation of the 3D effect. | Wheel marks: need for regular refreshing of the marking. |

| Site reference | Type of product | 3D effects visible | Evolution of vehicle speed | Pedestrian and driver behaviour | Questionnaire acceptability, others? | Other problems |
|---|---|---|---|---|---|---|
| **R3** | Cold resin | Limited perceptibility (short time, weather). | Speed decreases in the direction with no 3D effect and remains constant in the direction with 3D effect. | / | Pedestrians: no change in users' opinions attributable to the 3D effect. | Wheel marks: need for regular refreshing of the marking. |
| **R4** | Cold resin | Limited perceptibility (short time, weather). | Decrease in speed | / | Pedestrians: no change in the opinion of users before/after installation of the 3D effect. | Wheel marks: need for regular refreshing of the marking. |
| **R5** | Cold resin | Limited perceptibility (short time, weather). | Decrease in speed, but this may be due to nearby construction works and J11 beacons marking the middle of the road. | / | Pedestrians: increased sense of safety. | Wheel marks: need for regular refreshing of the marking. |
| **P1** | Heat-sealed | Perceptible at a distance of 15m for two seconds. | Very slight decrease in speed due to re-marking rather than to the 3D effect, as the decrease is also observed in the direction with no 3D effect. | More pedestrians crossing the road.<br><br>Better observation of pedestrian priority by motorists.<br><br>3D crossing barely noticed by the users<br><br>No change in behaviour. | Drivers aware of the 3D effect pedestrian crossing: no change in their behaviour.<br><br>Pedestrians: no change in behaviour or sense of safety<br><br>Users did not find 3D effect useful | |

*/ means, information not available or not suitable for the technical situation.*

### 4.2.2 Accident rate

**There were no injuries due to road traffic accidents at the sites evaluated during the trial period.**

This can be explained, in part, by the bias introduced in the selection of some of these sites: sites where there had been few or no accidents in the five years preceding the installation of 3D pedestrian crossing.

### 4.2.3 Limitations of the evaluations carried out

In three cases, no proper evaluation was carried out, instead, a mere opinion was sent by the local authority by email in the case of Annemasse and Saint-Etienne-de-Saint-Geoirs, and by letter in the case of Grigny.

Of the local authorities that performed an evaluation, some issues were not addressed. Guidance on speed measurement was drafted by Cerema and put on line but was not a requirement.
So local authorities had considerable freedom, resulting in non-homogeneous data collection methods (user questionnaire, speeds). In particular, speed measurement methods can introduce bias. In fact, the same thing is not measured when you put a Viking type stealth radar in place 24 hours a day over a number of days, or when measurement is carried out over a short period of time using a hand-held radar (entailing the risk of the operator being spotted and themselves introducing bias by dint of their presence), or yet when a data-gathering radar is used.

There are inherent difficulties in field evaluations. The conclusions reached in some of the evaluations are sometimes poorly argued.

In a number of cases, the parameters of the road introduce bias: existence of works in the neighbourhood modifying the traffic, layout modifying the crossing in addition to the 3D effect, a change in the speed limit during the trial phase, etc.

In addition, remarking a pedestrian crossing to make it more visible can lead to a temporary reduction in average speed. The introduction of a 3D pedestrian crossing (new paint strips) may have had this beneficial effect without being related to the 3D effect.

In some cases, the size of the samples analysed (number of people observed or surveyed) is insufficient for meaningful analysis of before/after variations.

There was no information on the accessibility of the 3D crossing, for example, possible reactions of guide dogs to different marking in the reports submitted.

There was no evaluation of the 3D crossing at night. However, problems with perception of the 3D effect when there are shadows point to difficulties. Its visibility at night probably varies in accordance with illumination by vehicle headlights or street lighting. It would have been worth determining, *as a minimum*, whether the perception of “conventional” pedestrian crossings alone was affected.

Due to these limitations, only a part of the documents transmitted to us by the Delegation for Road Safety were used on account of the fragility of their scientific basis. On the other hand, some of the reports produced by Cerema stand out for their comprehensiveness.

### 4.2.4 Conclusions on the effectiveness of the 3D pedestrian crossings evaluated on the basis of standard criteria

#### *4.2.4.1 Little perception of the 3D effect*

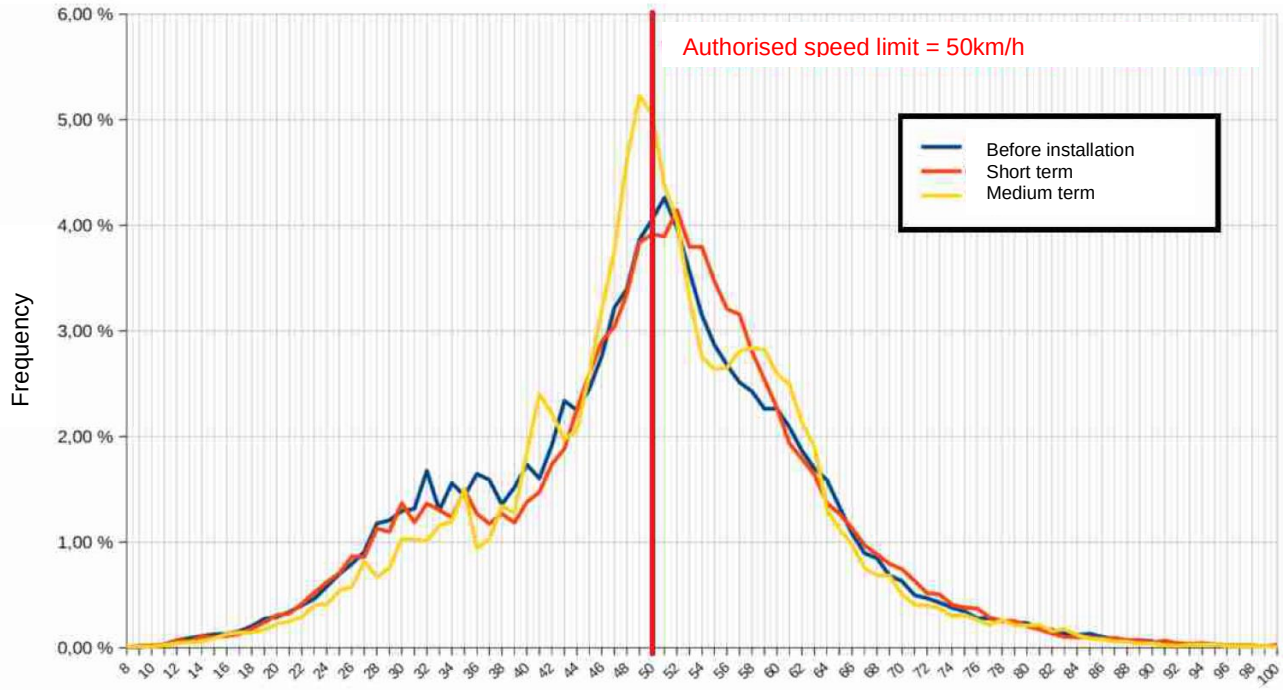
Some of the drivers interviewed did not perceive the 3D effect. For their part, the pedestrians did not notice the change of marking.

The problems with drivers' perception of the 3D effect can be explained by:

- Light levels and the angle of the sun's rays;
- Wet road surfaces modifying the perception of colours;
- Convergence line that is not in the middle of the traffic lane;
- Position on the crest of a hill;
- The existence of old road markings;
- A lack of contrast with the existing road surface;
- Shadows.
- The wearing of the paint a few months after installation
- Truck drivers' driving position

### *4.2.4.2 Speed consistency*

The distribution of speeds in the North to South direction is as follows:




When the speeds were measured, there was no reduction in vehicle speed observed due to the 3D effect that persisted over time. Speed reduction was merely based on opinion.

To illustrate this lack of change, see below the example of the evolution of the distribution of the speeds measured by stealth radars (Viking) over one week, before and just after implementation, and six months later in Bourgoin-Jallieu.

### *4.2.4.3 No effectiveness for road safety or user comfort demonstrated.*

There were few or no traffic accidents resulting in injury at the sites evaluated before and none during the trials.

Drivers reported no change in their behaviour.

In only one case was pedestrian and driver behaviour observed to have improved with the installation

of the 3D crossing, but these changes were not sustained over time.

One site demonstrated a beneficial effect. However, it is not known whether this is due to the 3D effect or just to the re-marking of the pedestrian crossing.

The sense of safety for pedestrians has not changed.

The case of cyclists avoiding the 3D crossing by coming off the cycle lane was noted in only one of the reports.

#### *4.2.4.4 No improvement in pedestrian crossing usage*

Some evaluations used the difference between prescribed and actual behaviour as a criterion.

The hypothesis tested was: would the presence of a 3D pedestrian crossing encourage pedestrians to use it? (Remember that using a pedestrian crossing is mandatory when there is one within a distance of 50m.)

In the case of Bourgoin-Jallieu, the answer is clear, see the table below. Although initially, some pedestrians were attracted by the very clearly decipherable appearance of this pedestrian crossing, six months later, old habits had returned, reflecting the absence of any benefit in using the 3D pedestrian crossing.

| **Henri Barbusse: what rate of pedestrians cross on the pedestrian crossing?** | | | |
|---|---|---|---|
| | Before | Short term | Medium term |
| **North pedestrian crossing** | | | |
| East-West Direction | 31% | 46% | 33% |
| West-East Direction | 50% | 66% | 50% |
| **South pedestrian crossing** | | | |
| East-West Direction | 58% | 77% | 68% |
| West-East Direction | 55% | 66% | 53% |

#### *4.2.4.5 Durability*

Several reports mention the poor performance of the 3D marking over time and, in particular, note a certain degradation after six months.

#### *4.2.4.6 Acceptability*

Without having knowledge of the additional costs associated with the 3D pedestrian crossing systems as compared to conventional pedestrian crossings or regarding doubts relating to the slipperiness of the 3D pedestrian crossings, user surveys show opinion is divided over these systems. Some of those surveyed had not noticed the presence of the 3D pedestrian crossing, some were interested in the concept, others were more circumspect, seeing it as more of a gimmick. There were reports of drivers being taken by surprise, resulting in scares that could have caused an accident. Finally, one user pointed out that focusing drivers' attention on making sense of this type of crossing, which can be hard to make out, could divert their attention from interpreting the overall road scene and, in particular, from detection of pedestrians.

## *4.3 Anamorphosis - a flawed idea*

True anamorphosis is only perceptible from one point, *See* 2.2.

None of the trials encountered or listed in this document seem to have taken this fact into account.

Companies were supplying a basic system that was supposed to be applicable everywhere, one that looked easy and attractive, and simple to implement.

This failed to take into consideration the composition of the vehicle fleet in which:

- The steering wheel is on the left;
- The driving position is fairly high;

Or the presence of motorised two-wheelers, most of the time riding in the centre of the traffic lanes. The addition of markings with non-approved paints with variable roughness is a real issue.

Finally, pedestrians, especially those with disabilities, may be disturbed by this unusual marking, which is no longer specifically intended for them.

## *4.4 Some comments on the proliferation of 3D pedestrian crossings*

The 3D pedestrian crossing has been marketed with an often misleading name by companies that did not specify its non-compliance with the regulations or the legal risk taken by the police authority installing it (non-compliance with the Interministerial Instruction on Road Signs and Marking (IISR)).

The 3D pedestrian crossing has been seen as a means of orchestrating a publicity campaign on the back of a low-cost innovation with articles in local newspapers or even television appearances, which were almost guaranteed at the outset.

The use of the 3D pedestrian crossing as a means of generating publicity also created significant pressure that did not allow time for a review of the situation before trialling. In addition, the cost of undertaking proper evaluation is significant (data collection + analysis), which explains the low number of evaluations carried out.

The *a priori* analysis of the anamorphic-design crossing posed potential difficulties for achieving the stated objectives. A number of cities conducted trials on roads not open to public traffic, leading to the decision not to go any further in view of the cost for the predictably low service rendered.

Some local authorities did not honour their commitments as regards evaluation (need for a baseline, unbiased measurements and an evaluation report).

Trials require a scientific and rigorous approach, which takes a relatively long time and a certain budget needs to be earmarked for this.

# 5 Conclusion

Based on the evaluations available, **3D pedestrian markings have been found to have no beneficial effect on the reduction of vehicle speeds, on driver behaviour in the medium term, or on pedestrians' sense of safety, regardless of the principle of the** crossing system implemented.

The 3D effect is most often not very or not at all noticeable and there are problems with its durability.

There were no accidents at the sites where they were installed and evaluated.

The beneficial change observed temporarily in the case of a limited number of 3D crossings seems to be due to the re-marking of the pedestrian crossings, which were often not very visible before the trial.

**The 3D pedestrian crossings require much more frequent and systematic maintenance than the horizontal marking of pedestrian crossings.**

**The "3D effect" pedestrian crossing is, therefore, a marking whose effectiveness has not been demonstrated as regards the objectives of improving road safety.**

**Given the much higher installation costs when compared with those of conventional pedestrian crossings, it does not seem advisable to include these 3D pedestrian crossings in the regulations.**

# 6 Appendix 1 Order of 29 June 2018

JORF No.0166 of 21 July 2018

Order of 29 June 2018 concerning the trialling of the application of road markings to indicate a pedestrian crossing with a three-dimensional effect following advance notification

NOR: INTS1808413A

ELI:https://www.legifrance.gouv.fr/eli/arrete/2018/6/29/INTS1808413A/jo/texte

Public concerned: road users, authorities in charge of road services, law enforcement agencies.

Subject: trialling road signs and marking

Entry into force: the legislation enters into force the day following its publication.

Notice: Many local authorities wish to install trial signs and marking to create pedestrian crossings with an added three-dimensional visual effect.
The purpose of the system trialled is to improve pedestrian safety when crossing a roadway by increasing perception of the pedestrian crossing from the point of view of the users travelling on the roadway.
This visual effect entails marking the pedestrian crossing with several colours and geometric shapes to create a relief effect.
This decree sets out the installation requirements stipulated, the procedure for notification by the traffic police authorities and the requirements for monitoring, evaluating and terminating the trial.

References: this order can be consulted on the Légifrance website (http://www.legifrance.gouv.fr).

The Minister of State, Minister of the Interior, and the Minister attached to the Minister of State, Minister of Ecological Transition and Solidarity, in charge of Transport,

Having regard to the Constitution, in particular Article 37-1;

Having regard to the code of relations between the public and the administration, in particular, Article L. 112-3;

Having regard to the French Highway Code, in particular, Articles L. 411-6 and R. 411-25;

Having regard to the modified Inter-ministerial Instruction on Road Signs and Marking of 22 October 1963, in particular, Articles 14-1 and 118;

Having regard to the Order of 24 November 1967, as amended, concerning road and highway signs and marking, in particular, Article 4 and the appendix thereto,

Establish that:

Article 1

An exception is made to the provisions of the aforementioned order of 24 November 1967 and Article 14-1 of the aforementioned instruction of 22 October 1963, to create a system of advance notification to the minister responsible for road safety, allowing the installation, on an experimental trial basis, of a road marking with a three-dimensional effect on certain pedestrian crossings known as “3D pedestrian crossings” (PP3D), having regard to the notification system introduced and to the nature of the message delivered by this marking, which is not defined by this order or by this instruction.

The “PP3E” (3D pedestrian crossing) road marking may be installed on a trial basis with advance notification. The characteristics of the markings trialled, the procedures for notification and evaluation regarding them, and their installation requirements as regards road safety and traffic, are established in Appendix I. The model notification is set out in Appendix II.

The crossing system shall be trialled until 1 April 2020.

The follow-up of this trial shall give rise to an intermediate and a final evaluation report. The interim report shall be submitted to the Highway Safety Officer and the Director of Transportation Infrastructure in electronic format no later than midnight on 31 December 2018. The final report shall be transmitted to the Highway Safety Officer and the Director of Transportation Infrastructure in electronic format no later than midnight on 31 December 2019.

Article 2

Depending on the circumstances, the Road Safety Officer and the Director of Transport Infrastructure may decide to suspend the trial, terminate it early or make it conditional upon new measures being taken.

Article 3

This order will be published in the Official Journal of the French Republic.

APPENDIX I

TRIALLING OF A THREE-DIMENSIONAL ROAD MARKING OF SOME PEDESTRIAN CROSSINGS AFTER ADVANCE NOTIFICATION

I. - Purpose of the trial

In order to allow a number of trials of road markings with a three-dimensional effect on certain pedestrian crossings known by the French acronym as "PP3D", this order derogates from the provisions of Article 14-1 of the aforementioned instruction of 22 October 1963, to create a system of notification prior to the installation of this marking.

The trial derogates from the provisions of the aforementioned order of 24 November 1967, in order to experiment with "PP3D" road markings in view of the nature of the message delivered by these markings, which is not defined by this order or by this instruction.

II. - Reason for the trial

The purpose of the trial is to improve the safety of pedestrians crossing a roadway by increasing the perception of the pedestrian crossing from the point of view of users travelling on the roadway.

III. - Description of the 3D-effect crossing system trialled and its installation requirements

A. - “PP3D” road marking

The “PP3D” (3D-effect pedestrian crossing) road marking shall be installed in place of an existing pedestrian crossing, defined by order of the authority holding the power to police traffic. It thus retains all the rules relating to pedestrian crossings for all users, in particular, the prohibition of stopping or parking, as defined in Article R. 417-11 of the French Highway Code.
“PP3D” road marking cannot be installed when R12 lights, as defined in Article 7, Paragraph 5 of the above-mentioned order of 24 November 1967, are installed.
“PP3D” road marking shall consist of white-coloured rectangles applied as per the regulations set forth in Section 118 of Part VII of the Inter-ministerial Instruction on Road Signs and Marking (IISR).
Colours other than white, yellow, blue, green and red can be used achieve the 3D effect.
Any additional products used achieve the 3D effect must meet the criteria defined in the regulations and standards for road marking products, with the same level of requirement as the certified white products currently used.
“PP3D” road marking shall be installed on a straight section of the roadway, at a distance of more than 50 meters from a bend or intersection.
“PP3D” road marking shall only be installed on a road where the maximum speed limit is 50km/h or less.
The minimum distance between two “PP3D” road markings shall be 100 meters. This distance shall be measured as the crow flies between PP3D crossings located on the same street or on adjacent streets.
Each “PP3D” road marking shall be monitored and evaluated individually.
No other sign and marking exemptions are provided for this trial.

B. - Advance notification of marking

Any authority holding the power to police traffic wishing to install “PP3D” road markings shall send notification in electronic format as per the model shown in Appendix II to the Minister in charge of road safety - Road Safety Delegation/Signs and Traffic Office (bsc-sdpur-dsr@interieur.gouv.fr).
The sending by the minister in charge of road safety of the acknowledgement of receipt, as per Article L. 112-3 of the code of relations between the public and the administration, shall allow the notifier to install PP3D crossing.

C. - Public Information

The list of “PP3D” pedestrian crossing road markings concerned by this trial shall be published on the road safety website (http://www.securite-routiere.gouv.fr).

IV. - Trial evaluation procedures

Each trial shall give rise to an intermediate and a final evaluation report commissioned and financed by each road manager from expert advisors in the road sector of their choice.
The interim report shall be submitted to the Highway Safety Officer and the Director of Transportation Infrastructure electronically in .pdf format by midnight on 31 December 2018.
The final report shall be transmitted to the Highway Safety Officer and the Director of Transportation Infrastructure in electronic format no later than midnight on 31 December 2019.

The evaluation of the trial shall include the following:

- description of the location of the “PP3D” road marking (type of road, width of the carriageway, number of lanes, width of the lanes, type of road junction, proximity of public facilities (schools in particular), presence of street lighting);
- description of traffic (main flows (especially pedestrians), traffic volume, existence of regular public transport lines);
- description of the “PP3D” road marking (size, shape, colours, materials used);
- speed analysis before the installation of the “PP3D” road marking and afterwards;
- analysis of accidents causing injury that occurred at the location of the “PP3D” road marking dating back five years before installation;
- a qualitative analysis based on a user questionnaire;
- a description of the crossing system’s installation and maintenance costs;
- a qualitative analysis on the durability of the 3D pedestrian crossing system from the point of view of the road maintenance services.

V. - Traffic safety

In the event of an incident or accident related to the road marking trialled, the Road Safety Officer and the Director of Transportation Infrastructure shall be informed by the notifier.
Depending on the circumstances, the Road Safety Officer and the Director of Transport Infrastructure may decide to suspend the trial, terminate it early or make it conditional upon new measures being taken.

APPENDIX II

MODEL PP3D NOTIFICATION FORM

Name and postal and e-mail address of the traffic authority

Name and postal and email address of the road manager

Location of the PP3D (street name, address)

Planned date of installation

End date of implementation (if before 1 April 2020)

In order to be included in the framework of this national trial, the notifier shall commit to abiding by all the installation requirements thus defined:

- The PP3D crossing shall be installed in place of an existing pedestrian crossing, defined by order of the authority holding the power to police traffic. It thus retains all the rules relating to pedestrian crossings for all users (in particular, the prohibition of stopping or parking as defined in Article R. 417-11 of the French Highway Code);
- The PP3D cannot be installed when R12 lights, as defined in Article 7, Paragraph 5 of the above-mentioned order of 24 November 1967, have been installed;
- The PP3D crossing consists of white-coloured rectangles applied as per the regulations set forth in Section 118 of Part VII of the Inter-ministerial Instruction on Road Signs and Marking (IISR);
- Colours other than white, yellow, blue, green and red can be used achieve the 3D effect.
- Any additional products used to achieve the 3D effect must meet the criteria defined in the regulations and standards for road marking products, with the same level of requirement as the certified white products currently used.
- The PP3D crossing shall be installed on a straight section of the roadway, at a distance of more than 50 meters from a bend or intersection;
- The 3D pedestrian crossing (PP3D) shall only be installed on a road where the maximum speed limit is 50 km/h or less;
- The minimum distance between two 3D pedestrian crossings (PP3D) is 100 meters; - This distance is measured as the crow flies between 3D pedestrian crossings (PP3D) located on the same street or on adjacent streets;
- Each 3D pedestrian crossing (PP3D) shall be monitored and evaluated individually;
- No other sign and marking exemptions are provided for this trial.

Date

Name and capacity of the signatory

Signature

Dated 29 June 2018.

The Minister of State, Minister of the Interior,
For the Minister of State and by delegation:
The Road Safety Officer,
E. Barbe

The Minister to the Minister of State, Minister of Ecological Transition and Solidarity, in charge of transport,

For the Minister and by delegation:
The Director of Transportation Infrastructure,
S. Chinzi

“ ”

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