Innovation and Specification:a forceful partnership
The example of low noise pavings and a method for measuring the noise of traffic rumble in Paris

C. FRETET
Ville de Paris – France
Christian.fretet@mairie-paris.fr

SUMMARY :

Pinpointing a need and outlining an aim are part of the sponsor's role, when approaching any industrial partners likely to supply an innovatory solution.The need to codify the solution is then met through specifications.The forceful partnership of "innovation-specification" is then created and is the trigger for progress.
Innovation where roads are concerned generally involves specifications, which on the one hand, provide an outline of the new product and on the other, define which tests will identify and check it.
Moreover, the new product or range of products can also create the need, in return, for an innovation which will measure the new product's efficiency and which will in its own way, create a need for specificatios regarding a method for carrying out measurements.
This has been the case for innovation concerning low noise pavings.The City of Paris, insufficiently satisfied with the solution provided by porous, bituminous concretes,has approached firms, seeking some innovation regarding those solutions most suitable to the urban milieu.
The City of Paris has sought out the LREP in order to come up with a method which involves the profession at every stage of the authentication process.Today, a standardised method for measurement in proximity, is being focused on.
This latest stage allows the use of accoustic specifications to be introduced within the CCTP of the markets in order to outline the performance levels expected of these materials.
This example illustrates that innovation and specification are linked and interact, bringing about even more technical advances and in the present case, meeting the demands of local inhabitants..
The partnership between the City of Paris, the firms and the State Technical Network, has triggered the emergeance of innovatory products and a method for assessing their performances, as well as the emergeance of specifications defining products and methods. .

KEYWORDS : ROAD/NOISE

1. NOISE IN AN URBAN CONTEXT

Noise, whatever its source, has become a major preoccupation of everyday life.In towns, many things cause it: the neighbourhood environment, various activities and traffic.It is to an extent, the price we have to pay in our modern-day societies and is nowadays considered to be a social phenomenon.It is contributary to both physical and psychiatric disorders.It disturbs work and even sleep.Its detrimental effects are costly to society.
Among the afore-mentioned causes of noise, transport-related noise is heavily responsible for nuisance experienced.The rumble of car traffic constitutes a background noise which is

almost permanent, whereas air or rail-related noise is more precisely timed but more intense.

2. NOISE-ABATEMENT POLICY

2.1 National Policy

The first text relating to the noise-abatement campaign dates back more than ten years; it is the law of December 31st., 1992.
In the sphere of road-related infrastructures, other texts have appeared to complete and specify the terms of the law known as the NOISE law.
The documents in question are the decree of January 9th. 1995, the order of December 12th.1995 and the circular of December 12th. 1997 which point out the implementation procedure. Another circular of June 12th.,2001, creates "noise observation-points for land-based transport".
Finally, a European directive has made it imperative that noise maps be drawn-up within five years for population sprawls of more than 250,000 inhabitants and within ten years for sprawls of more than 100,000 inhabitants.Procedural plans based on this cartography, should have been worked-out within six years.

2.2 City of Paris Policy

The noise-abatement campaign is an integral part of the larger policy for the lay-out and useage of public areas.
At the end of 2000, The Ile de France Region granted itself an Urban Mobility Plan, necessitated by the 1996 law on air space.The City of Paris turned this plan down in favour of a Paris Mobility Plan.This stipulates that areas meant for traffic must be reviewed, in order to decrease sound-related disturbance and improve safety.A new sectioning and reappraisal of public space involves instigating measures at the same time, which will aim to limit traffic-generated noise.
Besides these organisational measures aimed at reducing car traffic, the choice of road paving is an important factor in the procedural options available to local communities.
In fact, whereas road paving in the open countryside is not considered to be any more than an additional means alongside other possible procedures for rducing noise (charts, phonic protection),it is, where towns are concerned, the only available technical means alongside the protection of facades.

3 THE NEED TO INNOVATE

3.1 Paving

Well before the Urban Mobility Plans appeared, the City of Paris became involved in research towards more noise-absorbant road paving.
During the 90's, road paving with drainage ability inspired new hope, since besides its ability to drain, which was advantageous in terms of safety as it curbed aquaplaning, it also turned out, due to its porosity, to be capable of absorbing frequencies and thus decreasing the rumbling noise generated by the contact between tyres and road surfaces.

Unfortunately,the drainage ability in an urban setting appeared to decrease sizeably and quickly due to the clogging of gaps in the road paving as it drained, simultaneously depriving it of its acoustic qualities.
More or less effective unclogging, activated by water at high pressure, had little durability and was expensive, thus with an additional burden of upkeep.
In order to seek out a new technical orientation for itself, The City of Paris called on the ability of its professionals to innovate.
Research revealed that two aspects neede treating: grain and porosity.The more the "D" or largest grain decreased, the more the noise diminished..Whereas when one used a formulation 0/14 or 0/10 in a classical way, 0/10 formalas were widespread and 0/6 formulas appeared, one could note 0/4 on an experimental level.
The porosity increased when sand presence was lowered and/ or aggregates, which are in themselves porous, were used.
Ever since 1996, The City of Paris has largely used these new materials for the renewal of layers of Paris roads,.the choice of granulometry being made in accordance with the category of traffic.
Over time, formulas resulting in better performances have been developed.The use of bonding agents modified by polymers, has allowed for a reduction in the thickness of the paving layer in order to obtain a mastic with less sand and hence a better macrorugosity, with greater adhesiveness.Additives such as rubber powder for example, have again improved the features.
As always, the formulation becomes a quest for compromise between several elements;the compromise being all the more difficult as the former requirements of resistance, adhesivenes have in addition, the new one of accoustics.

3.2 Noise Measures

The French norm S31.119 classified as "the nature of accoustic attributes of road paving in its setting-accoustic measurements during passage"is dependent on two measuring procedures in the setting, one called VM: "véhicule maîtrisé" (traceable) and the other, "véhicule isolé".(non-traceable).
The measurement recommendations for the VM method require a road closed to traffic and the positioning of a microphone 7,5 metres from the the roadside without obstacles between or vehicles which are not traceable accoustically: V.I. Method
These conditions can obviously not be met in towns and it hasn't been possible to adapt these methods to the urban milieu.
It thus became necessary in this milieu too, to create afresh and outline a "realistic" method, adaptible to the conditions of urban traffic.
The City of Paris therefore approached The Regional Laboratory of East Paris (LERP) which had already been conducting work in this vein since 1990 and had thus gained experience.A partnership was formed between road professionals, the LREP and the City of Paris to come up with a functional tool, which would guarantee a shared reading of results.
This operation has resulted in the creation and realisation of a measuring method called "en champ proche" (at close proximity), which has the advantage of showing the nature of a whole stretch of road and no longer just a specific point, since the measurement is carried out continuously and therefore also tests the homogeneity of the road paving.

4.NECESSITY FOR SPECIFICATIONS

4.1 The Measurement of Noise.

Although not standardised nowadays, this method is nevertheless well documented.
Principle and equipment: an omnidirectional microphone with measuring capacity is placed at the back of the vehicule, 60 cm. from the wheel axle and 15cm. from the ground.The vehicle is also equipped with a tachometer and a tape recorder.Thus, accoustic pressure and speed are measured both simultaneously and continuously (photo 1).
Meteorological conditions for measuring: temperature of the air; temperature on site,temperature within shelter are measured 1.20 metres from the ground and must be kept within +5° to +30° c. Moreover, the road must be dry on the surface and within the paving, if it is porous.

Conditions on site: the measurements are carried out on a horizontal road or on a slope, to render the engine noise less invasive.The trajectory of the vehicle must be such, that there is no obstacle less than a metre away from the microphone.
The vehicule: its suspension must allow a distance of 15cm. to be maintained between the microphone and the ground at a steady speed.The tyre of the trial wheel is of a radial structure and blown up to 2,5bars The wheel is fitted with a full hubcap (photo no. 2)

PHOTO 1
Le matériel d'enregistrement : un simple magnétophone relié au microphone extérieur.
Recording equipment: a simple tape recorder connected to the external microphone.

PHOTO N°2

Operating Method: The vehicle is driven, if possible at a steady speed of approaching 50km./h but can be adapted to traffic conditions

4.2 The Road Paving

On the strength of road surface noise being measurable according to a method which is backed by specifications, the fixing of specifications for road paving performance, can therefore be envisaged.

Thus since 1996, a long period of data acquisition concerning all types of urban road paving has been undregone, in order to establish a classification of these in accoustic terms, (see chapter 5 for results).
After analysis of the measurements and appraisal of the performance averages of the materials, it seems possible to determine the maximum accoustic levels required on a new road paving of the less noisy bituminous covered type
The levels accepted for new road-paving, measured at six months are:

83 dB(A) for the BBM 0/6
85dB(A) for the BBM 0/10

The Roads and Mobility Department at Paris City Hall has thus included its accoustic performance specifications on the market, in a call for offers of equipment that it made during the period from 2001 to 2003, as well as for the production of coverings in thin bituminous concrete.

5 RESULTS

5.1.Analysis of a recording

All extraneous factors are eliminated from the results i..e.passing over gratings or any white lines on the ground and they are split up into a samples of short duration (about 2 seconds long).The results are checked through and recorded according to the methodology described in annexe B of the norm NF31.119.The reference level has been fixed at 50km/hr.for the urban setting.
The spread of points around the straight regression line, gives information about accoustic homogeneity in paving (figure no.1)

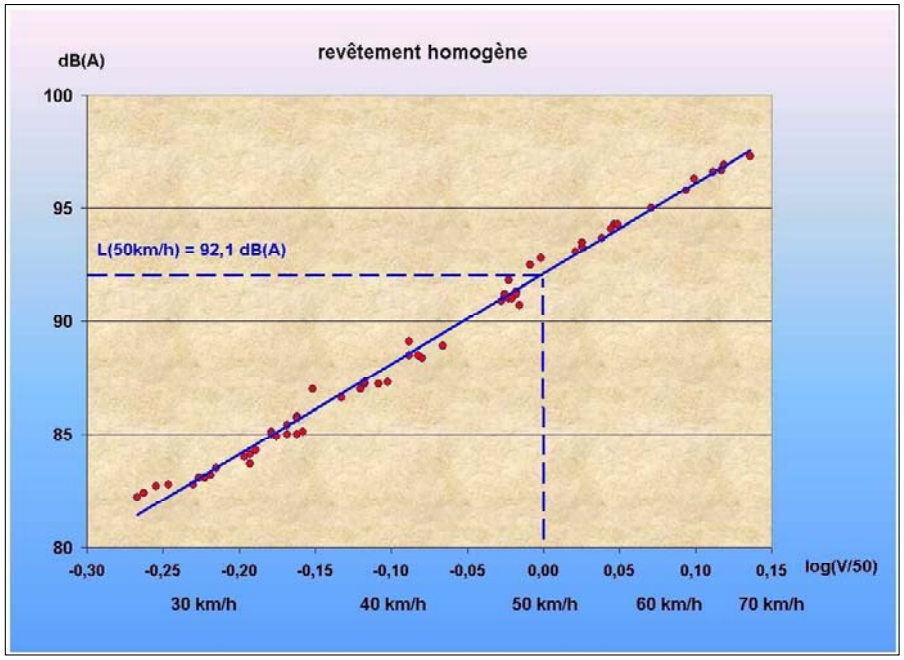

FIGURE N°1

5.2 The Data Bank

The accoustic-related result of every road paving tested is recorded on a data base.The display emulates the presentation of the VM Data base set-up on a national scale.The figure below,(figure no.2) shows the results obtained at 50 km./hr.on different types of urban road pavings.

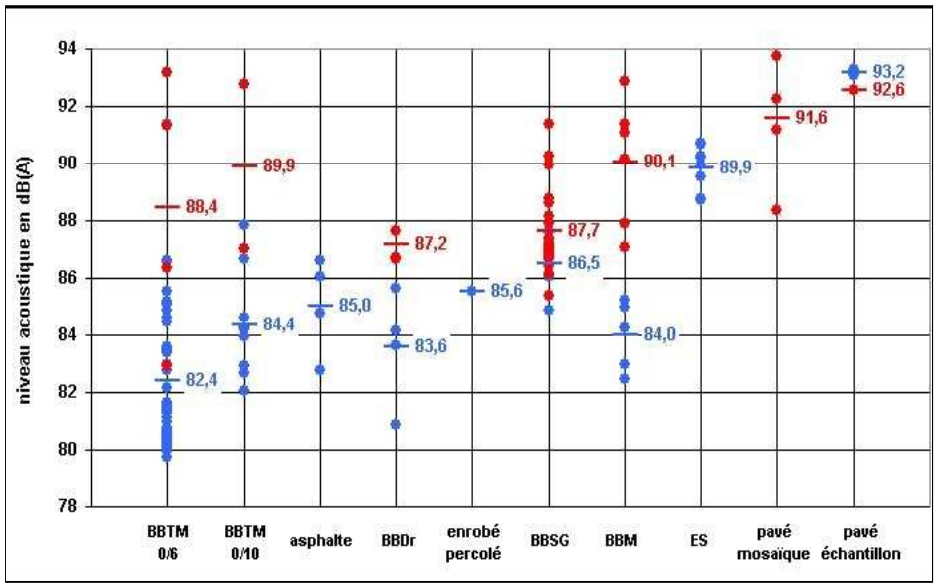

FIGURE N°2

The blue points are representative of the different types of new pavings (6 months) and the red points of former pavings (over 3 years).
It can be affirmed that the classification of pavings acquired "in proximity" tallies with that revealed by the "in situ" method, which confirms its basis.for classification.

6 PERSPECTIVES

6.1 On Material Performance

The professionals, with the support of sponsors are undoubtedly going to further their research and experimentation into the accoustic attributes of new materials, improving the products or inventing new ones. Opportunities to innovate are opening up in this field.
Moreover, it is noteworthy that even if the City of Paris has rather focused on the development of bituminous road coverings, the idea that significant progress can be brought about through use of hydraulic concretes is still envisageable, by relying on size grading and treatment of surfaces.Certain countries are specialised in this area.
The second main branch of research and progress remains the capacity of the accoustic attributes to last..
A program of measures is envisaged to test, after three years, a significant number of slabs that had been measured when new.
So the focus could be directed at performance specifications maintainable over time.

6.2 On the Measuring Method

After the LREP had come up with the "in proximity" method, the City of Paris along with their partners, the Road Eqipment Laboratory for the City of Paris acquired itself a vehicle and a staff able to carry out this type of measurement.That allowed capacity for measurement to be increased, the data base to be expanded more quickly but also testing of the measurements' suitability in terms of repeating and reproducing them.
Today, numerous bodies (laboratories, firms)are showing continuing interest in these measurements and developing various materials and methods.Such inspiring diversity prompted the LREP to submit a project with norms which will allow all participants to meet face to face. and will culminate in a method being outlined whose speecificatios are shared by everyone.

6.3 Measurement On Building Facades

The final aim of low noise pavings is to improve the local inhabitant's sense of well-being, by reducing the level of noise emanating from facades.
Noise measurements of facades before and after putting new coverings in place are therefore necessary in order to appreciate the comparative decrease in sound level and noise level, within the norms that decide if a building can be placed above or below a legally determined threshold.They also conclude the necessity of possible supplementary measurements (accoustic adaptation of windows, for example).
The correlation of these measurements of noise emanating from facades with the measurements of traffic rumble before and after, is very valuable.
The few, first measurements carried out, highlight the heavier nature of road-related noise; the decrease of sound level on the roadway is broadly reflected in the noise level emanating from facades and all the more so, given that night traffic in particular, is high.

7 CONCLUSION

Following these first few years of research into developing low noise paving, it is clearly obvious that innovation has arisen from the definition of a new sponsorship need and that the former, rapidly emerged from a partnership, willing to share the calculated risks inherent in every innovation.
Innovation in the sphere of road pavings, itself gave rise to a fresh need in the area of performance assessments.From that arose the possibility of outlining specifications to measure the quality of materials.
This is only one example which shows that innovation and specification are closely linked and that they are logical conclusions of each other, together forming a forceful partnership and trigger for progress.

References

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