FRENCH METHOD FOR THE USE OF "OUT OF SPECIFICATION" AGGREGATES IN ROAD SUBBASES

P. DUPONT
Service d'Etudes Techniques des Routes et Autoroutes, France
pierre.dupont@equipement.gouv.fr

V. LEDEE
Laboratoire Central des Ponts et Chaussées, France
Vincent.Ledee @ lcpc.fr

ABSTRACT : The search for savings in the road project leads to employ as well as possible locally available materials. To reach this objective, it's sometimes necessary to use aggregates which do not respect the specifications of the road building owners. The use of these aggregates is also justified by the exhaustion of some of the traditional resources and by the increasing requirement regarding protection of environment. In France, actions are currently carried out to support their development in road bases and subbases, especially in the areas where problems of provisioning arise with acuity. The communication aims to present, through concrete examples, the method for qualification and promotion of such aggregates, recently conceived by the French road engineering committee. This method is based on two principal topics : the evaluation of the incurred risks by on site experimentation of innovating techniques, and the exploitation of the results to fix conditions of use and operational limits.

KEY-WORDS: PAVEMENTS/AGGREGATES/SPECIFICATIONS/EXPERIMENTATION/SOFTENING/VALIDATION.

1. FOREWARD

Aggregates represent a raw material necessary to building and civil engineering, without which the carrying out of works would be impossible in the nowadays state-of-art. They make up the hydraulic concrete skeleton, pavements layers framework… and the quality of homes et roads depends on theirs …

France geology determines the production areas location according to the kind of subgrades. It provides a wide panel of miscellaneous formations and, consequently, aggregates.

Sedimentary rocks are actively exploited along rivers and tributaries : towns have settled in and grown up near water, in valleys. Thus, alluviums generally make up the nearest traditional building materials ; These are as well the easiest to extract. Furthermore, the diversity of sediments (mineral composition, grading), when they exist and subsist, enable to answer to nearly all the demand.
The proximity of consumption locations, the wide panel of qualities, the moderate production costs, account for the significant rise in alluvial materials exploitation and their predominant place in aggregates market. The legislation strengthening on quarries and on the protection of water supplies, the depletion of some veins, the competition relating to grounds occupancy, the increased public awareness to

environmental issues, all these restraints contribute to limit extractions in alluvial sites, and even to close some veins.

Massive calcareous rocks outcrop mainly in sedimentary basins and in new range of mountains.
Calcareous aggregates meet technical requirements of usual demand : hydraulic concretes and rideability. Most of them provide proper road aggregates but their use in wearing courses is limited since they are liable to polishing.

Massive eruptive rocks are especially exploited in old massifs.
Eruptive aggregates are suitable for hydraulic concretes manufacturing and performing of usual rideability works. Many are first-rate components of road techniques and especially of those aimed to wearing courses. Some may be used as rail tracks ballast.

In addition, artificial resources may potentially be used, notably in road technique, subject to prior successful study results. Let's quote for instance the co-products of iron and steel industry (blast furnace slags, steel slags, electric furnace slags), the co-products of mining industry (coal schists), materials derived from constructions pulling down, bottom ashes from incineration of household refuse.
The present policy dealing with environment is bent to promote their use with respect to environmental and technical rules aiming to minimize pollution and confusion hazards.

One has however to bear in mind that Contracting Authorities use preferably the nearest aggregates from construction sites because restraints of distance and transport cost usually turn out to be higher than those of technical use. Moreover, long-haul aggregates flows are extremely low. They nearly all deal with peculiar needs which require specific aggregates as for instance heavily travelled wearing courses.
It bears out the regional and more often local feature of aggregates market, and accounts for short-haul road transports significance as well as the wide territorial scattering of production sites.

But the evocation of resources origin is not enough to specify their uses. Among a same family, geotechnic features may be very scattered. As well as people formerly selected the fittest stones to roads construction ("The pave must make a plain sound at hammer", "the sand must crunch in the hand"), road engineers nowadays enforce technical requirements to aggregates.

The French standard specifies the aggregates categories through several features association : categories related to intrinsic features of aggregates, to manufacturing features of aggregates and sands. It refers to all aggregates, whether they be natural or artificial, and all possible uses, building as well as civil engineering.
The standard ranks aggregates according to performances relating to mechanical strength, grading, cleanliness… But it does not tell the aggregates categories suitable for each kind of use. It is up to Contracting Authorities to choose the fittest categories to their needs and to write them down in their own technical regulations as use specifications.

2. USE SPECIFICATION FOR TECHNICAL ROAD AGGREGATES

2.1. State technical policy

For the trunk road network, use specification are fixed according to traffic, layer position in the pavement structure and the road technique used for its carrying out (stabilized or not with a hydraulic or hydrocarbon binder, cement concrete). They are all the more demanding for heavy traffic is higher, the concerned layer is closer to pavement surface, the binder is softer, its content is lower and its setting time is longer, lastly for the mechanical features of the road product used are lower. They take as well into account a would-be heterogeneity of aggregates supplies and a usual level of construction hazard.

These use specifications have been established from results of research, laboratory studies and construction practices one the one hand, and from pavements behaviour assessments on the other hand. They are furthermore confirmed by experience gathered thanks to construction, rehabilitation and maintenance works on trunk roads network for more than thirty years. They enable to undertake buildings in proper conditions and to reach the required quality on pavements when contract requirements and state-of-the-art rules dealing to manufacturing and laying of road products are met.

It is within this scope that, for the trunk roads network, the State has defined its technical policy dealing with pavements aggregates and has explicited the rules to use, for wearing courses on the one hand, and for road foundations on the other hand.

As far are wearing courses are concerned, use specifications in effect must be met, without any exception. As for road foundations, use specifications in effect must be applied; nevertheless, sporadic softenings can be accepted if results of prior experimentations on work sites enable to accurately appraise risks run : aggregates not utterly meeting one or several use specifications can thus be adopted.
But the use of such out of specification aggregates, i.e. not traditional, must on no account imply any decrease of pavements final quality. In other words, the pavements final quality must imperatively be the same whatever the performance level of aggregates mixed in road products of pavements subbases.

The use of not traditional aggregates entails a perfect control of their homogeneity as well as a proper knowledge of their limits and use precautions. It requires also the perfecting of specific methods adjusted to their geotechnic features, through for instance mechanical performances of road products and the design of road foundations, even pavement structures. It lastly enforces the implementation of peculiar work sites conditions enabling to reach the required level of final quality and to minimize at most the risks run.

In conclusion, the present national specifications dealing with road foundations aggregates will be kept as references. Local softenings to these national specifications are however allowable, but they require a serious analysis of use conditions and application additional constraints that their use entails in order to reach a similar quality warranty. These local softenings must derive from experience and the enforcement of a quality approach defined by a prior accurate study ; moreover, they are accepted by the State only if they have been first validated by SETRA and LCPC.

2.2. Public authorities technical policy

French territory is divided in several levels of administrative entities, called public authorities. Among them, local communities and counties manage also a huge roads mileage.

As far as local communities and counties networks are concerned, Contracting Authorities have generally defined rules similar to those of the State in sometimes bringing use specifications changes, linked to their network feature, to their aggregates local resources, and to the aim of their financial and technical policy.

3. ENHANCEMENT OF OUT OF USE SPECIFICATIONS AGGREGATES IN ROAD FOUNDATIONS

The use of such not traditional aggregates in road foundations can be accounted for the depletion of some traditional aggregates resources and by stressed requirements dealing to environment protection. The search of savings in schemes requires moreover to try to use at best available resources at hand, even aggregates which are still rarely adopted in usual applications for not always meeting use specifications in effect.

In France, many actions are nowadays led by working groups devoted to regional purposes in order to favour the rise of an economical and optimal management of existing and potential resources at Public authorities best interests. These actions are aimed to promote the use of not traditional aggregates in road foundations, for both the trunk roads network and the local communities and counties networks, notably in areas where aggregates supplies issues raise accurately. These working groups have in addition wished that a framework of rational approach of study and development of such not traditional aggregates in road foundations should be first defined.

To fulfil their expectation, CFTR (French Road Engineering Committee) (Comité Français des Techniques Routières) has scheduled in its scope these not traditional aggregates whatever their origin may be and more especially their qualification in road foundations and their acknowledgement at the local level. CFTR is an organization with a parity of representation including a “Contracting Authorities – Project Managers“ body made up of State departments representatives, technical departments of Public authorities and Motorways companies, and a “Contractors” body made up of road companies representatives, road materials manufacturers (aggregates, binders) and road equipments builders. CFTR is originally responsible for issuing technical assessments in the road field. The purpose of these assessments is to provide an unbiased point of view about the potential use of products, processes and equipments, when their newness or the one of their use does not (or not yet) entitle their standardization ; these assessments are drawn up as information documents dealing with the foreseeable behaviour of works to achieve.

CFTR , at all involved parts disposal, is the French authority the fittest to deal with this topical issue with high stakes which is the enhancement of not traditional aggregates in road foundations, because the body gathers with a parity of representation all components of the technical community and this new purpose enters into in the framework of its missions. Thus, CFTR has newly initiated two

procedures to validate regional technical guides on the one hand, and to issue certificates of regional use on the other hand.

3.1. Regional technical guides validation

The regional technical guide deals with a not traditional aggregate manufactured by all the quarries exploiting a homogeneous resource. It represents an information document aiming to define the potential uses of this not traditional aggregate in road foundations according to its geotechnic features and to state the conditions as well as the limits and precautions of use, on the basis of successful experimentations results gained on work sites.

The drawing up methodology of a regional technical guide follows three successive steps :
1) Risk factor identification
It is undertaken through the search of the flaw attendant to a feature weakness of the not traditional aggregate compared with the chosen standard reference and through the detection of the direct effect of the considered lack. The effect thus identified represents the risk factor, the influence of which on all the granular mix properties has to be studied.
2) Risk assessment
It consists of measuring the consequence of the identified effect on the final quality of the road product, even of the pavement structure. To this end, the application of a strict approach turns out to be necessary ; its main keynotes are the following :
- to characterize the not traditional aggregate with regard to mean values and deviations, and so for each controlled property,
- to search for the binder the fittest to physicochemical features of the not traditional aggregate and to optimize the Binder-Aggregate pair,
- to perfect the road product mix in laboratory, then possibly design the pavement structure,
- to define an on-site experimentation schedule dealing with test sections implementation and their monitoring over time,
- to strictly apply this schedule,
- to draw up the behaviour assessment,
- to identify conclusions.

3) Results enhancement
This third step is launched only if the results gained during the previous one are successful with regard to primary fixed goals. It is indeed the proper writing of the regional technical guide, which means to inform about the following topics :
- Origin and features of the resource,
- Exploiting conditions of the resource,
- Manufacturing conditions of the not traditional aggregate,
- Geotechnic features of the not traditional aggregate with specification of the suggested relaxing with regard to the chosen standard reference,
- potential common uses with conditions, limits and precautions of use,
- Other would-be uses during experimentations, possibly,
- Quality approach,
- Brief presentation and assessment of works enabling to define the relaxing in hand.

The approach initiative, the drawing up of the regional technical guide, its publishing and dissemination rest with involved parts at the considered local level, CFTR validating the scheme before its publishing only at these local authorities request. The validation essentially boils down to check the adopted methodology, the document content, as well

as the reliability and the consistency of suggestions relating to the chosen standard reference.
There are already several regional technical guides thus validated dealing with not traditional road aggregates (soft limestones East of Paris, materials coming from former constructions pulling down and bottom ashes produced by incineration plants of household refuse located in Paris area …). Road foundations have even been laid down according to these documents recommendations.
Moreover, other regional technical guides dealing with miscellaneous not traditional resources, still little known or used but of undoubted interest in the following years, are nowadays in hand.

3.2. Issue of regional use certificates

The regional use certificate refers to a not traditional aggregate manufactured by a single quarry exploiting a resource which is already the subject of a regional technical guide. It represents an information document which mainly aims to confirm the belonging of the not traditional aggregate to the scope covered by the regional technical guide as far as geotechnic features and possibilities and conditions of use in road foundations are concerned.

The request initiative and the attendant file drawing up rest with the exploiting contractor. The regional use certificate is issued by CFTR only on the basis of the mere statement of the asking contractor and after close examination of the imparted file as a backing to the certificate request.

I would be proper to specify that a regional use certificate has just been issued by CFTR and that others should be soon.

4. CONCLUSION

CFTR has implemented methods and structures enabling to study not traditional aggregates and to develop their use in road foundations. Regional technical guides, completed by regional certificates of use, provide an information dissemination backing that Contracting Authorities and Project Managers as well as Road Contractors can use if they regard them relevant and fit relative to their own technical requirements and economical constraints. The fact that the suggestions displayed on these documents had been defined from full scale experimentations results, induces to think that risks encountered are controllable and all the better that the quality approach is strictly met.