SAMARIS NEWS

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Survey: better use of alternative materials is needed

- by Denis Francois, LCPC

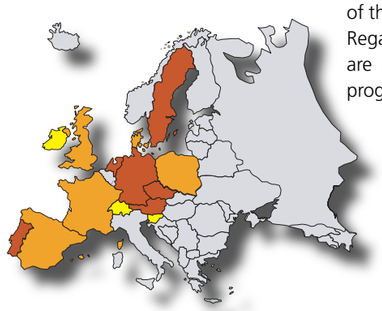
Re-use of materials is an issue of growing importance throughout Europe. Hence, in road construction a reliable and operational method for assessing the engineering and environmental properties of alternative materials is becoming necessary. The need can vary from country to country depending on amount and nature of national deposits of raw materials and on national experience in the field of re-use of materials. Given this, one may ask if the consolidation of scattered national expertise wouldn't be beneficial to the whole community. But is it really necessary? And is it feasible?

To get an answer to these questions, a survey questionnaire was sent to representatives of the 15 countries involved in SAMARIS. Nine alternative materials were specifically considered in this questionnaire (municipal solid waste incinerator bottom ash, coal fly ash, building demolition crushed concrete, road crushed concrete, basic oxygen furnace slag, electric arc furnace slag, crystallized blast furnace slag, vitrified blast furnace slag, and decontaminated soils). Answers were collected from 7 countries (Austria, Denmark, Spain, France, Slovenia, Sweden, and The Netherlands) and gave rise to a report (Deliverable 4, available on the SAMARIS website). Some nations delivered their answers too late to be included in the report; others are still collecting data. Such late answers may be included in a future SAMARIS document.

From the regulatory point of view, the survey shows the importance of the European level example for member nations. Indeed today, the status of these materials is only defined through the classification of wastes. For the same reason, the absence of a satisfactory definition for secondary raw material at the European level, leads generally to unsatisfactory status at national level.

Regarding the assessment of materials the survey highlights the variety of national toolboxes for the engineering properties in relation to their experience in re-use. For municipal solid waste incinerator bottom ash, coal fly ash, crushed concretes and vitrified blast furnace slag a significant number of technical documents are available in some countries. Conversely, there can be a national production, but no technical document for the assessment. Regarding environmental properties, a general lack of reference documents is noted. Moreover, the few which exist are mostly management documents rather than technical ones.

Thus, the survey reveals a widespread need at the nation level for an improvement of the use of alternative materials through a better assessment of their potential. It suggests that joint work at the European level is the right way to further development at the nation level and for gathering and sorting the mixed information from nations. Progress towards a common methodology of assessment of the engineering properties could begin with an assessment of the existing methods and tests available in some nations. Regarding environmental properties, specific developments are necessary and this could be based on the research progress achieved in that field during the last decade.



The SAMARIS consortium

SAMARIS (Sustainable and Advanced MAterials for Road InfraStructure) is a Shared-cost RTD and Demonstration research project from the Growth program of the 5th Framework Programme, partially financed by the European Commission and partially from the partners' national resources. The project was initiated in FEHRL, the Association of European National Highway Research Laboratories.

Research Coordinator for SAMARIS structures research: Aleš Znidaric, ZAG, Slovenia
Research Coordinator for SAMARIS pavement research: Jean-Michel Piau, LCPC, France
SAMARIS project coordinator: Jørgen Christensen, DRI, Denmark

The SAMARIS Secretariat, Danish Road Institute
attn: Ms. Sys Mikkelsen
Road Directorate, Niels Juelsgade 13
DK-1059 Copenhagen K, Denmark

e-mail: sm@vd.dk
Phone: (+45) 3341 3038
Fax: (+45) 3332 9830

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FEHRL

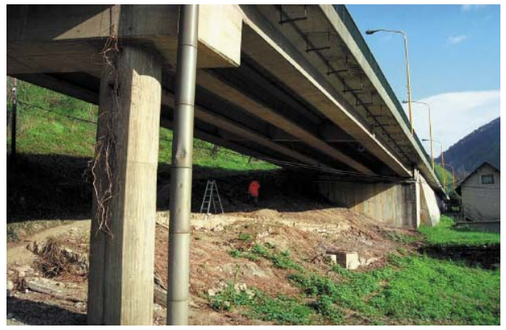
How much do bridges vibrate ?

- by Aleš Znidaric, ZAG, Slovenia

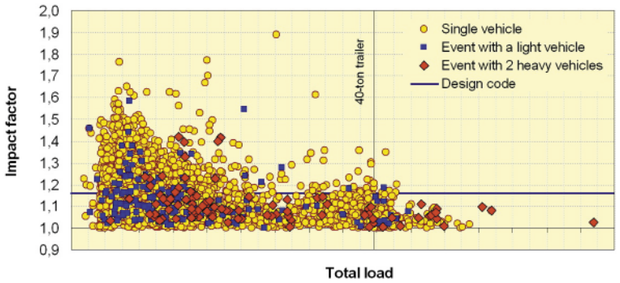
It is well known that many bridges, especially those with their natural frequencies close to the frequencies of the heavy vehicles' body bounce, can vibrate considerably. Such pronounced dynamic behaviour can often be observed on simply supported bridges with spans from 30 to 50 m, with the fundamental natural frequency around 3 Hz. Even more so, if pavement is not smooth or there is a severe bump just before the bridge. Theory however shows that such extreme dynamic behaviour usually occurs due to the individual, often lighter vehicles on the structure and that the so called Dynamic Amplification Factor (DAF) decreases as number of vehicles and their gross weight increase. This means that when assessing the bridge loading, combining the two extremes, of static loads and of dynamic amplifications, gives over-conservative values. This is not necessarily bad when we design bridges for 100 years, but can be very expensive if due to such assumption we would strengthen an existing bridge unnecessarily.

To confirm the theoretical assumption, an extensive experimental programme has been performed. A bridge with 30 m spans has been instrumented for bridge weigh-in-motion measurements to collect loading data of each vehicle that crossed the bridge. In addition, software has been developed which for each of these loading events, with individual or multiple vehicles on the bridge, evaluated in real time the DAF. Furthermore, 2-week measurements were done before and were repeated after the pavement on the bridge has been resurfaced. The preliminary results are fully in line with expectations: 1) Due to very rough pavement, DAFs due lighter single vehicles reached 1,9 (loading was almost twice as high as due to the static weight of that vehicle). 2) During the extreme loading events, i.e. with two heavy vehicles on the bridge at the same time, DAFs were very low and did not exceed 3%, almost 6 times less than the DAF value prescribed in the design code. 3) Smooth pavement decreased the average DAF values of heavy loaded events with 50%.

More measurements are needed to strengthen the conclusions. However, even these first measurements, designed and performed in SAMARIS, indicate that under the heaviest vehicles bridges vibrate much less than we tend to think when we assess them.



Weigh-in-motion measurement of energy crossing vehicle.



New measurements indicate that bridges tend to vibrate less under heavy vehicles than earlier assessed.

Repeated load triaxial test for unbound granular materials

- by Erik Nielsen, Danish Road Institute

One of the aims of WP5 of Samaris is to develop new methods to assess the mechanical performance of unbound granular materials and in particular their resistance to permanent deformations.

This research is based mostly on cyclic triaxial tests, which allows study of the cyclic behaviour of unbound granular materials, under various stress levels, representative of traffic loading. The test is performed on a cylindrical specimen, enclosed in a rubber membrane and placed in a triaxial cell, filled with water. It consists in submitting the specimen to a cyclic axial load, and, simultaneously, a cyclic or constant confining pressure, and measuring its response in terms of axial and radial strains. Views of the test equipment used in Samaris, and of an instrumented specimen (diameter 160 mm), are shown on figure 1. and on the frontpage.

Figure 1.

The cyclic triaxial test can be used to determine both the elastic modulus of unbound granular materials and their resistance to permanent deformations. This represents an important step forward compared with present methods of characterisation of unbound granular materials, which are generally based on empirical criteria, such as grading, aggregate resistance and cleanliness of fines. The test can be used for ranking of materials, and also to develop material models which can be used for pavement modelling and design. In Samaris, the main objective is to develop models for the prediction of rutting of granular layers.

Options for rehabilitating structures

- by Richard Wood Ward, TRL

Bridge engineers faced with deteriorating structures have a number of rehabilitation options ranging from 'do minimum' in the short term to major structural works or even replacement of the structure.

One of the factors that influences the rehabilitation strategy selected is the distribution of deterioration within the structure. This is illustrated in Figure 2a for the case of a reinforced concrete structure at risk from reinforcement corrosion. Cases A and B represent a structure with a narrow distribution of deterioration. Case A might be appropriate for the application corrosion inhibitors and Case B might be appropriate for the application of Ultra High Performance Fibre Reinforced Concretes (UHPFRC). Case C represents a structure with a much wider distribution of deterioration and this would require a combination of rehabilitation techniques. Such structures are easier to handle because some deterioration is visible, although not dominant. The variation of deterioration over a structure is affected by many factors including: design, construction process, and the microclimate around the structure. The spatial variation of the deterioration will affect whether a single method or a combination of methods provide the most optimal strategy for rehabilitation.

It is thus important to provide the engineer with a palette of intervention methods which range from non-invasive techniques such as the application of surface applied corrosion inhibitors or hydrophobizing agents to more invasive techniques such as concrete replacement.

Figure 2b. illustrates two different rehabilitation strategies, E(t) represents the effects acting on the structure and R(t) the resistance provided by a rehabilitation method. Strategy A is based on a single intervention $R_A(t)$ at time t_0 and strategy B is based on multiple interventions $R_B(t)$ during the service life of the structure. Both methods take into consideration the changes in condition that occur over time. Each single intervention is an improvement; however, strategy A minimises the impact on the functionality of the structure.

In determining a strategy it is necessary to take account of both the direct costs of the works and the indirect costs incurred as a result of restricted use of the structure while it is being rehabilitated. The life of the repair, future maintenance costs and the required life of the structure all need to be taken into consideration. Future costs are usually discounted to equivalent costs at the time of the rehabilitation. In addition it is necessary to consider non-technical issues such as environmental, social and political impacts.

The SAMARIS project is developing guidelines that will assist engineers take all these factors into account and enable them to select the most appropriate strategy for their structure.

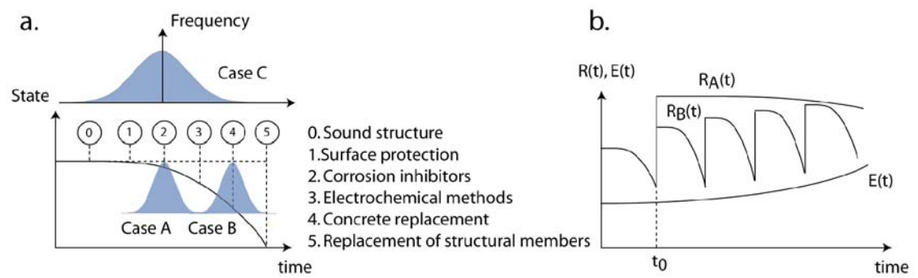


Figure 2. Distribution of levels of damage in a structure and methods of intervention a), comparison of two strategies for rehabilitation, b).

FeRRM05

The next FEHRL Road Research meeting will be held in the week 13-17 June 2005 at the Diamant Conference Centre in Brussels

With parallel sessions and up to 600 participants, the event will be structured around a series of technical workshops and strategy sessions. The SAMARIS project will host a session on Safe and durable pavements from recycled and residual materials and another on New approaches and materials for the maintenance of concrete structures.

Scenarios and priorities in European road research will be considered in strategy sessions that will address decision-makers, business developers and managers. This will also be an opportunity to debate about the need for an approach which reflects national and regional differences. Learn more on www.fehrl.org