Low Noise Road Traffic – Results from test site B56

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Introduction

In Summer 2001 the project "Low Noise Road Traffic" as part of the integrated national project "Low Noise Traffic" was started [1]. Together with 15 partners from industry (tire, car and road) and research (engineers and universities) a research field with seven main topics was investigated.

- Two models for noise emission from tires and from roads were developed using the finite element method and multivariate analysis.
- Two new in situ measuring systems for airflow resistance and acoustic impedance have been built.
- New low noise tires have been developed and a study for reconditioned truck tires.
- A tire housing for a passenger car has been optimised.
- The building of stone mastics concrete was optimised and a test site with different surfaces of open porous asphalt was laid.
- The building process for cement concrete was investigated in detail, especially the vibrations of the machines used.
- A low noise bridge crossing was constructed and tested.

Most of the project has been completed now, except for the finite element model for noise emission from tires which will follow in summer 2004.

Test site B 56

On the test site B 56 near Düren several new road surfaces were laid or existing surfaces were modified (see Figure 1).

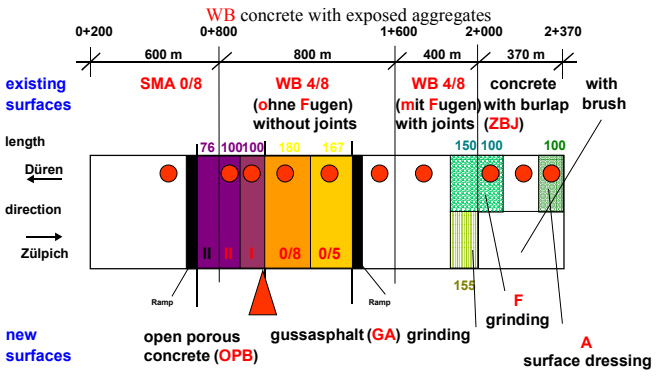

Figure 1: Constructions on test site B 56

- For reference stone mastics asphalt 0/8 (SMA 0/8) and concrete structured with burlap (ZBJ) were built in 1997.
- Two different types of open porous concrete (OPB) were laid in 2002 on top of asphalt and on top of concrete without joints.
- Gussasphalt (GA) 0/5 and 0/8 were built in 2002 in an improved manner.
- Some trials of grinding (F) of and dressing (A) on existing surfaces were made in 2002 also.

Before, during and after building the surfaces, a lot of measurements were carried out. Material testing and construction quality tests won't be covered here.

For the acoustical characterisation the following measurement were carried out:

- Acoustic impedance of laboratory samples and drilled cores of open porous concrete with the impedance tube.
- Acoustic impedance in situ with a newly developed device.
- Airflow resistance along the surface with a newly developed device.
- Texture both two and tree dimensional.
- Coast-by measurements [2] with newly developed tires on a modified car.
- Statistical pass-by measurements [3] on all surfaces.

The latter two items well be discussed in detail.

Coast-By and Statistical Pass-by

The coast-by measurements were carried out in autumn 2003 with newly developed tires on a modified car.

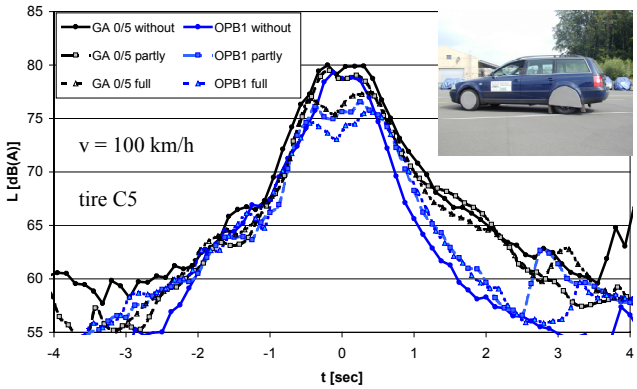

Figure 2: Level-time diagram of the coast-by of a modified test car with a set of new low noise tires on GA 0/5 and on OPB1 at 100 km/h.

In figure 2 the level-time diagram for a modified test car with a set of new low noise tires on GA 0/5 and on OPB1 at a speed of 100 km/h is shown. The differences for the three car configurations without modification, with partly modification consisting of absorber material in the rear wheel housing and a full modification with additional shielding of the rear wheel housing are only slight. But one can see the steep drop of level with time for OPB1 after passing by.

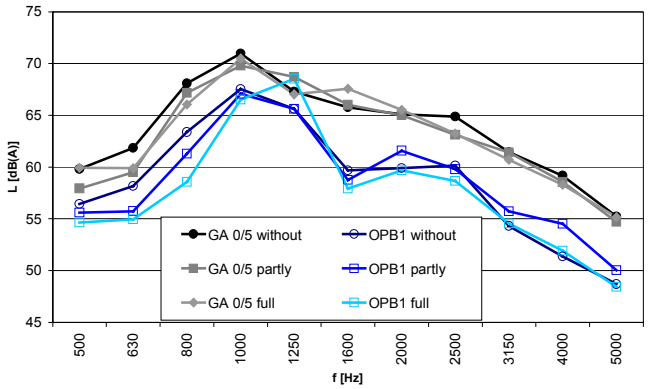

Figure 3: Spectra at maximum level of coast-by of a modified test car with a set of new low noise tires on GA 0/5 and OPB1 at 100 km/h.

The spectra at maximum level are shown in figure 3. The drop in level at 800 Hz and 1600 Hz for OPB1 in comparison with GA 0/5 can be seen. The performance of the modification depends on frequency and surface type.

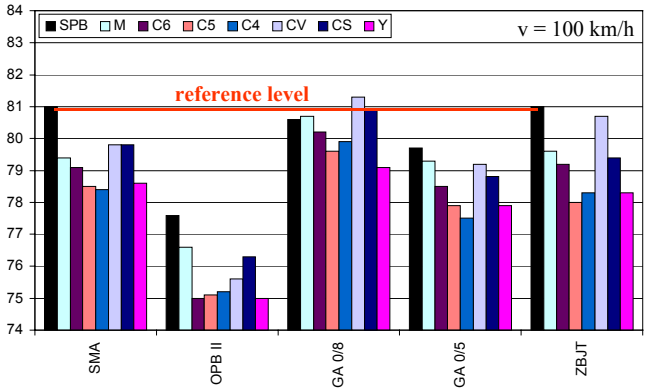

Figure 4: Results of the statistical pass-by measurements and of the coast-by measurements of a test car with different sets of tires at 100 km/h on five surfaces.

The results of the statistical-pass by measurements for passenger cars in summer 2003 and of the coast-by measurements of a test car with seven different sets of tires at a speed of 100 km/h on five surfaces is shown in figure 4. The reference level for that speed taken from SMA and ZBJT is about 81 dB(A). A SMA and ZBJT all tires show up to 3 dB(A) less in sound pressure level compared with the SPB measurements. The reason is that the tires were optimised for these surfaces. GA 0/5 is on the same level as the reference while GA 0/8 is about 1.5 to 3.5 dB(A) below. For OPB II (= OPB1), where the difference to reference level is 3.5 to 6.0 dB(A), the situation is even more .

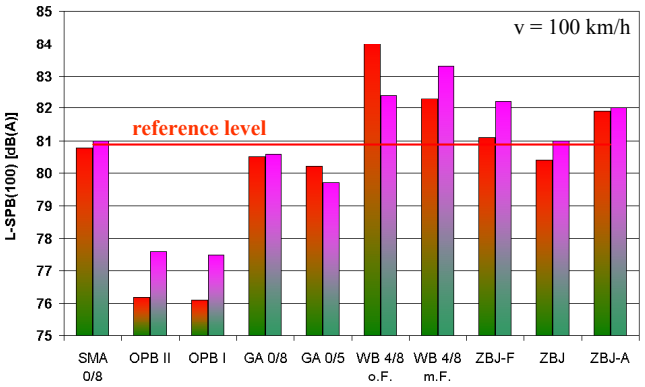

Figure 5: Results of the statistical pass by measurements on ten surfaces in 2002 and 2003.

The result of the statistical pass-by measurements for passenger cars of ten surfaces in 2002 and 2003 are given in figure 5. The reference level remains nearly unchanged. The levels of concrete with exposed aggregates (WB) without and with joints respectively (o.F. resp. m.F.) are above the reference level of the concrete with grinding (ZBJ-F) and the concrete with surface dressing (ZBJ-A). This is due to the fact that the constructions were built not very well. Gussasphalt GA 0/8 an especially GA 0/5 perform well as seen before. But open porous concrete OPB1 and OPB2 rose from about 5 dB(A) to about 3.5 dB(A) within one year. Perhaps this is because of clogging from agricultural vehicles in autumn 2002 and spring 2003.

Conclusion

The first project “Low Noise Road Traffic” is completed in most parts now. Detailed results within a report will be available in summer this year. The mechanical and the acoustical finite element models of tires will be completed until summer.

For next year a new project on “Low Noise Road Traffic” is planned. One focus could be on reducing truck noise. Another the combination of surface types for different road lanes with noise abatement by noise shields.

References

[1] Integrated Project FV 3000 – “Low Noise Road Traffic”, Concept February 2001 (unpublished)

[2] ISO 11819-1:1997 Measurement of the influence of road surface on traffic noise – Part 1: Statistical Pass-By method

[3] ISO 13325:2003 Coast-By Method for Measurement of Tyre/Road Sound Emission