German Regulation for Noise Barriers on High-Speed Railways and Review of an Approved System by Forster

Nathan Binette
Peter Seelmann
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The German Railway (DB) issued regulation RIL 804.5501 entitled ‘Noise Protection Systems at Railway Lines’ with new demands for noise barriers on railways beginning July 1, 2010.

Since this adoption all noise barrier elements must now be approved by the EBA (Federal Railway Agency) prior to use along railways.

The Regulation covers noise barrier applications for all speeds. This presentation however focuses on details of the specification pertinent to Noise Barriers on High Speed Railways.
Topics

- Primary Concern
- Regulation RIL 804.5501
- Load Tests
- Fatigue Tests
- Empirical Analyses
- Conclusion
- Solution
Problem:

If a train is passing a NB with \( v = 300 \text{ km/h} \) high dynamic load of pressure and suction, will effect the NB

At a distance of 3.8 meters from the middle of the track and a height of 5 meters from the top rail, the resonance frequency of a typical steel post overlaps the range of the frequency of pressure and suction wave. \((v = 86.6 \text{ m/s}).\)

After many load cycles tremendous damage will occur.
Panel Deflection resulting from Pressure / Suction Loads.

Measured deflection (x10) of panel resulting from high speed train activity.

Dr. Kiesselbach Consulting, Vienna, Austria
The Regulation is divided into eight sections:

1. General
2. Planning Principles
3. Constructive Requirements
4. Acoustic Requirements
5. Measurement of Noise Barriers
6. Material Requirements
7. Railway Earthing
8. Quality Assurance

With Six Appendices:

1. Limits and Tolerances
2. Primary Tests for Wall Segments
3. Acoustic Testing
4. Walls Near Overhead Power Lines
5. Dynamic Analysis for Pressure / Suction Loads
6. Anchoring of Noise Barriers

Sections most relevant to high speed railways, consideration of cyclical loads, are highlighted.
Section 5.4 – Effect of Pressure and Suction from Trains

- Identifies load conditions for pressure and suction for various standard conditions.

Section 5.5 – Evidence for Loading Capacity, Usability, and Fatigue Safety

- Requires verification of fatigue safety. For concrete and steel, published fatigue strength curves may be checked to verify fatigue safety. For other materials it is necessary to test fatigue strength in accordance with App 5.

Appendix 5 – Noise Barriers Dynamic Analysis for Pressure / Suction Loads

- Dynamic load pattern was determined by measurements made by Evonik in cooperation with University in Wuppertal Germany.

- Fatigue tests apply the maximum load in both pressure and suction at a rate of 4 hertz for 2 million cycles (expected number of cycles in 20 years).
Testing at Evonik Para-Chemie

• First tests for the railway noise barrier application were conducted with 3 meter by 2 meter panels (approximately 10’ x 6.5’) at Evonik Para-Chemie in 2005.

• 10 Million load cycles were applied at a rate of 3Hz.

• The deflection of the panel in each direction was 40mm.

• The Soundstop panels and rubber gasket profiles remained undamaged.
Testing at Evonik Para-Chemie
• The Italian railway administration Italferr started to develop guidelines for noise barriers at high speed railways.

• Evonik Para-Chemie participated and made a test with 2 million load cycles.

• The scope of this test was to deflect both the frame and the soundstop panel together.

• The deflection of the frame was 33 mm

• The combined Soundstop panel and frame passed the test

• Since we have met the requirements of the Italferr with internal test we made an official test at an Italian Institute

• ACRYLITE® Soundstop passed the test successfully.
Testing at Politecnico di Bari Italy
Evonik made preliminary tests in accordance with the EBA (German Railway Ministry) and Prof. Hanswille of the University Wuppertal to prove that Soundstop is capable and simplify testing requirements / specifications for our customers.

ACRYLITE® Soundstop passed all tests and can be used at the German Railway

The test results have been submitted to the EBA

However, each frame provider must conduct tests with Soundstop to verify the capability of their frame.
Pressure and suction scheme and characteristics of a passing train acc. to RIL 804.5501
Testing at Bergische Universität Wuppertal

Determination of the characteristic fatigue strength at 75% of the bending strength
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Characteristic fatigue strength over load cycles.

Red line is load (6 ksi) at which 2 million cycles results in failure.

Blue line is 75% load (4.5 ksi), tested until failure...

At 25% load, still greater than max pressure / suction load, sample never fails.
REGULATIONS and APPROVALS

- Regulative RIL 804.5501(2008) by the german railroad DB
- Guiding Papers according to RIL 804.5501
- Approval declarations are issued by the german railroad federal office.
- Typical eurocodes
EMPIRICAL STUDY

Analyses Components

Analyses System
CONSTRUCTION

Special corner joint solution

Transparent Material EVONIK
Sound Stop

Aluminium Profile Frame

Special damping parts
CONCLUSION

• Very special requirements
• Fatigue strength verification required for all materials
• Empirical analyses for all components
• Life cycle tests for the element system
• Use is regulated by separate approvals
• Solution is a quality product by partners with long lasting experience
SOLUTION

ALL APPROVALS FOR HIGHSPEED RAILROADS

EXPERIANCE MORE THEN 25 YEARS

COOPERATION ALL OVER THE WORLD

HIGH TECH COMPETENCE

SOLUTIONS FOR ALL KIND OF NOISE PROTECTION
THANKS FOR ATTENTION !!