

16. SLOVENSKI KONGRES

O PROMETU IN PROMETNI INFRASTRUKTURI

ZAG

ZAVOD ZA
GRADBENIŠTVO
SLOVENIJE

SLOVENIAN
NATIONAL BUILDING
AND CIVIL ENGINEERING
INSTITUTE

Meritve emisij hrupa in vibracij za razvrščanje dilatacijskih spojev na avtocestah

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Uvod

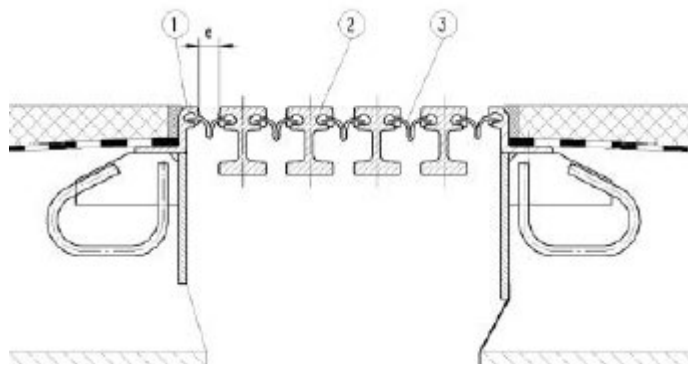
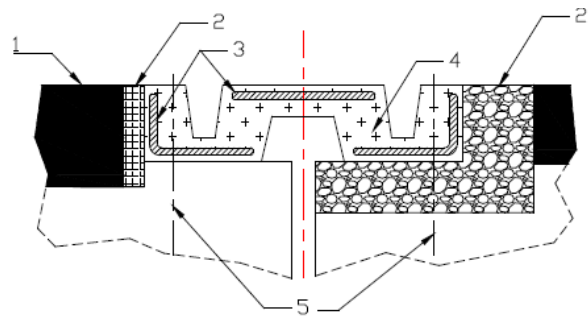


Dilatacije
Podmežakla 1
Jesenice 2021

Kako
ukrepati?



Dilatacije kot vir hrupa



Expansion Joint Type	ETAG n°032 (part)	Description
Pokrite	2	This expansion joint is formed in situ using components such as waterproofing membranes or an elastomeric pad, to distribute the deformations to a greater width and to support the surfacing which is continuous over the deck joint gap. The components of the expansion joint are situated under the surfacing.
Asfaltne	3	An in-situ poured joint comprising a band of specially formulated flexible material (binder and aggregates), which also forms the surfacing, supported over the deck joint gap by thin metal plates or other suitable components. The joint material is flush with the running surface.
Enorežne	4	This expansion joint has lips or edges prepared with concrete, resin mortar or elastomer. The gap between the edges is filled by a flexible profile, which is not traffic load carrying.
Gumene	5	This expansion joint uses the elastic properties of a prefabricated elastomeric strip or pad to allow the expected movements of the structure. The strip is fixed by e.g. bolts to the structure. The joint subcomponent flush with the running surface.
Glavnikaste	6	This expansion joint consists of cantilever symmetrical and non-symmetrical sub-components (such as comb or saw-tooth plates), which are anchored on one side of the deck joint gap and interpenetrated to bridge the deck joint gap. The sub-components are flush with the running surface.
Podprte	7	This expansion joint consists of one sub-component flushed with the running surface, which is fixed by hinges on one side and sliding supports on the other side (by a second element), and which spans the deck joint gap. The expected structure movement is allowed through sliding on the non-fixed side of the hinged sub-component, i.e. on the supporting element that is anchored to the substructure.
Lamelne	8	This expansion joint consists of a succession of watertight sub-components (in the traffic direction) comprising movement-controlled metal beams supported by moveable substructures bridging the structural gap (i.e. cross beams, cantilevers and pantographs). The metal beams are flush with the running surface.

Meritvena oprema



Hrup in vibracije

2 x B&K 1/4" mikrofoni tip 4957, 1 x B&K merilnik pospeška tip 4508 (1 os), DAQ DeWesoft 16 kanalov; 20.000 vzorcev na sekundo.

GPS geolokacija GARMIN GPSmap 62s

Temperatura DAQ Keysight 34972A temperaturna sonda Pt 100 (2x)

Standardne referenčne testne pnevmatike ("SRTT") P1 v skladu s standardom ISO 11819-3

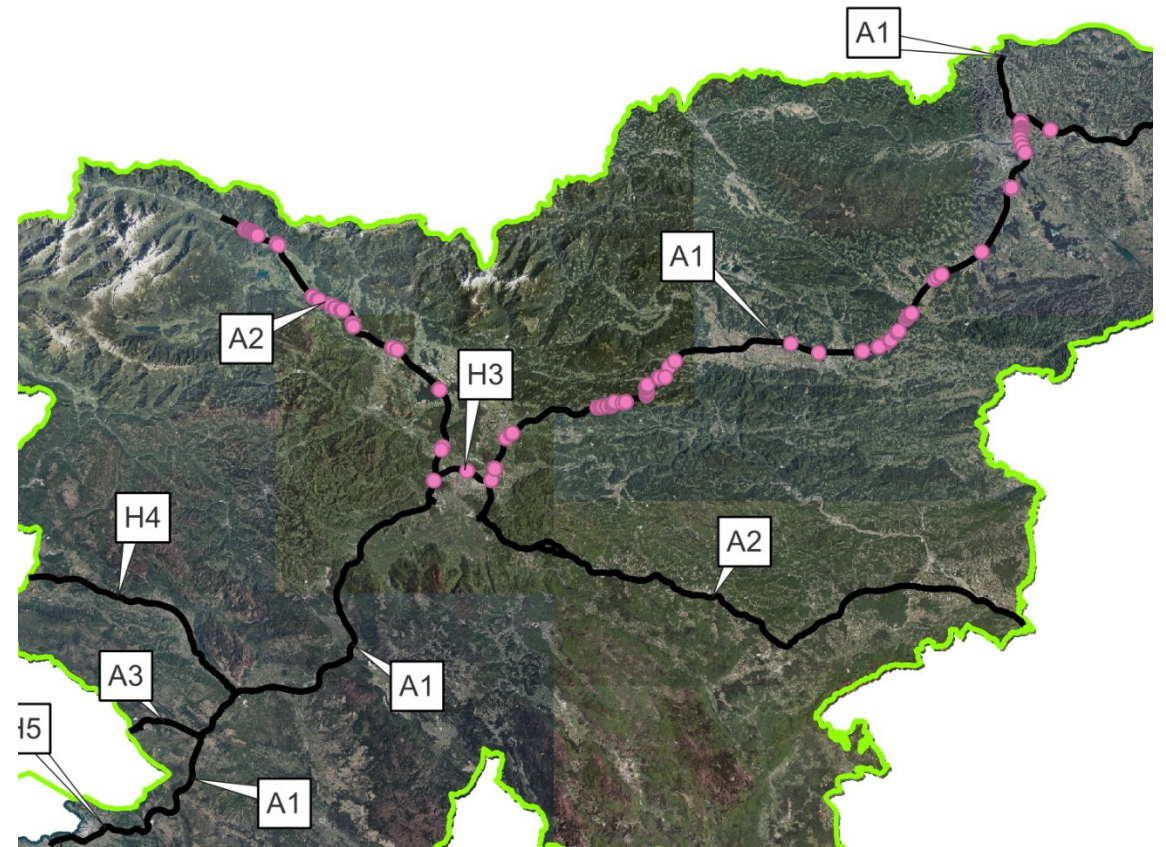


Terenske meritve

- Hitrost merjenja 100 km/h
- LAF na vrhu kot opredeljujoča značilnost
- Povprečje obeh mikrofонов
- Korekcija za spremembe hitrosti
- Korekcija za "ozadje" hrupa v cestnem prometu
- Brez korekcije glede na temperaturo ali trdoto pnevmatik

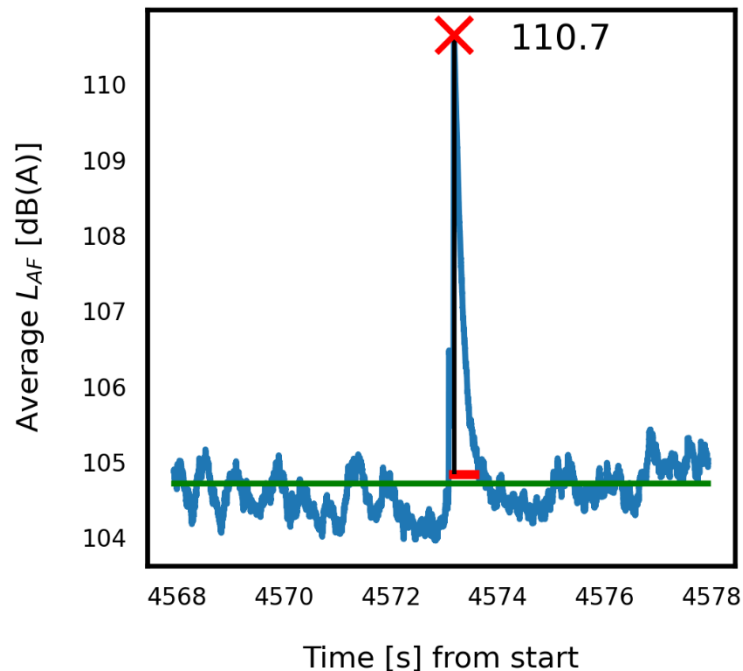
$$\bar{L}_{AF,b} = 10 * \text{Log} \left(10^{\frac{\bar{L}_{AF,peak}}{10}} - 10^{\frac{\bar{L}_{AF,background}}{10}} \right)$$

$$K = B * \text{Log} \left(\frac{v}{v_{ref}} \right), \quad \mathbf{B = 30}$$



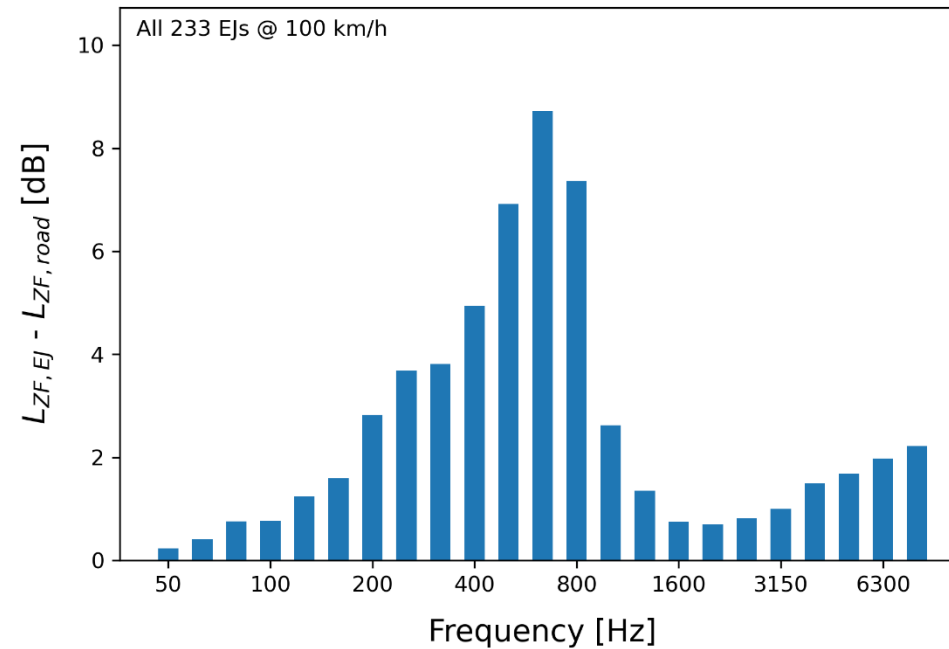
Rezultati

Example EJ measurement



Prometni hrup in hrup v ozadju (zelena črta)
Povprečna širina vrha 0,54 s (rdeča črta)

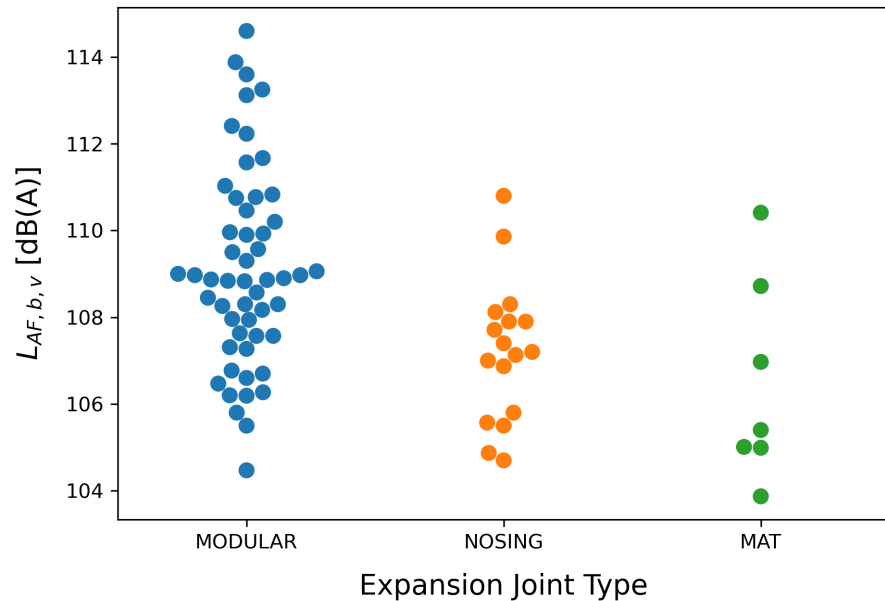
Spectral diff. EJ from road noise (average)



Večina prispevka hrupa je v 400 ~ 800 Hz, z največjim pri 630 Hz 1/3 oktavnega pasu

Hrup dilatacij

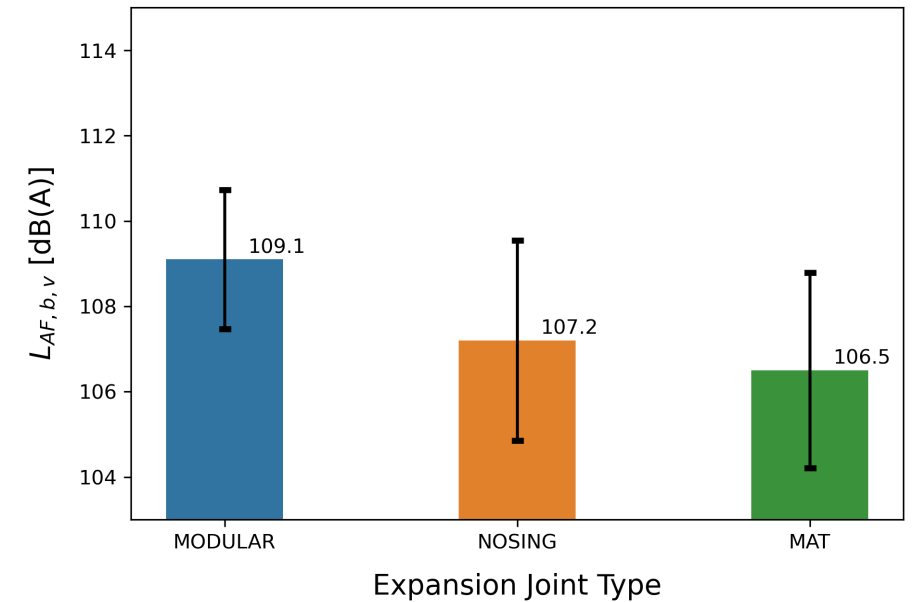
Distribution of measured EJ noise



Hrup glede na vrsto dilatacije

Lamelne: 109 dB(A)
Enorežne: 107 dB(A)
Gumene: 106 dB(A)

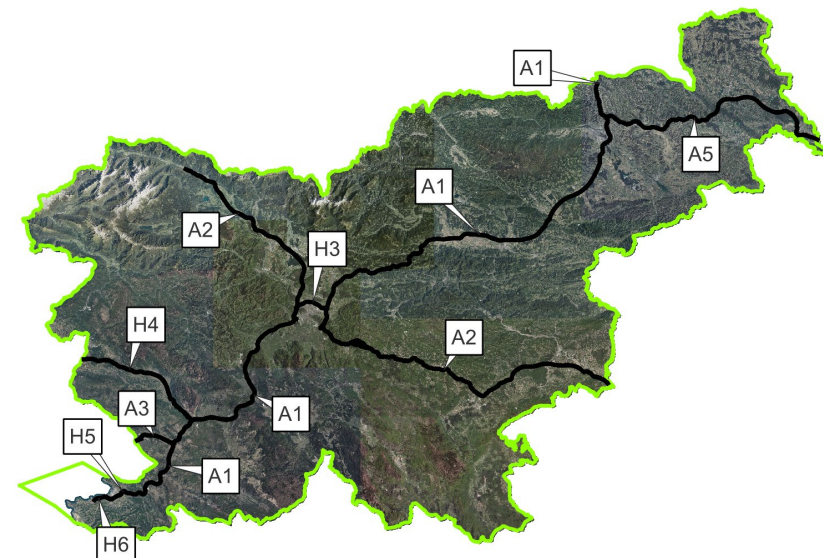
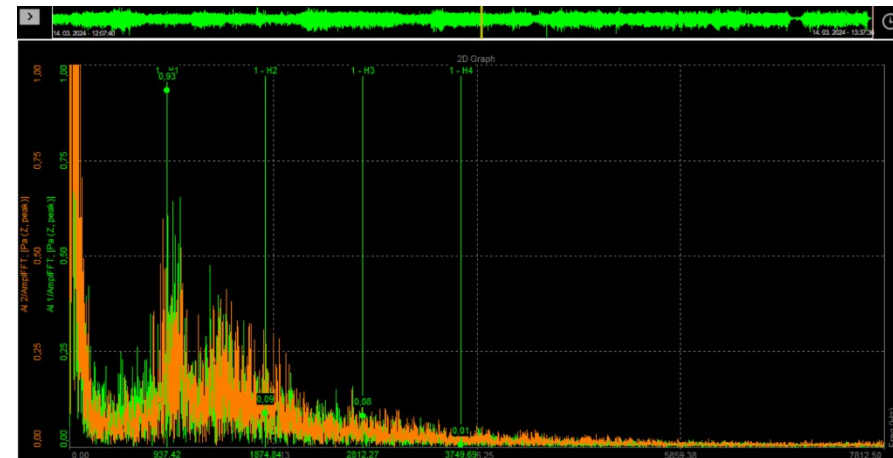
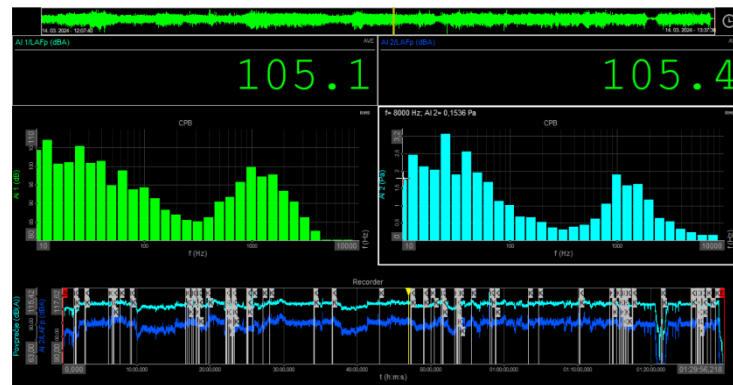
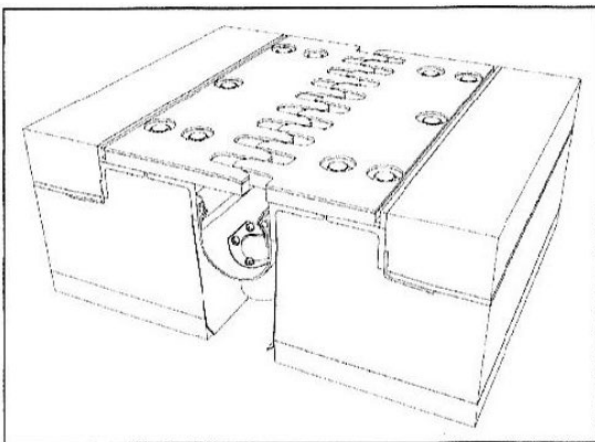
Distribution of measured EJ noise



Povprečne vrednosti hrupa z razponom 1σ (črna), glede na vrsto dilatacije

Izzivi in cilji

- **Kako izmeriti dilatacije z nizkim hrupom?**
- **Analiza vibracij pospeškometra**
- **Vključitev popravkov temperature in trdote pnevmatik**
- **Korelacija stanja in starosti s hrupom**
- **Redno spremljanje**



The logo for ZAG, consisting of the letters 'ZAG' in a bold, blue, sans-serif font, centered within a white square.

Hvala za pozornost.

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