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Vibration State of the Art Report 2

Impact and regulations

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Impact and regulations

Content of presentation

- Impact on buildings and fear of damage
- Impact on humans and perception
- Annoyance
- Complaints
- Legal obligations
- Standards and descriptors

Impact and regulations

Impact on buildings – Fear of damage

- Very common when the vibration exceeds the perception threshold level that fear of property damage occurs
- German Standard DIN 4150: 5 mm/s
- Norwegian Standard NS 8141-2:2013: 14 mm/s
- Known cases – very few and only minor damages
- Sensitive equipment – this is a risk since there are equipment and processes that tolerates very low levels

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Impact on humans

Threshold of perception according to ISO 2631
1.0 mm/s rms at 1 Hz and 0.1 mm/s rms at 10 Hz

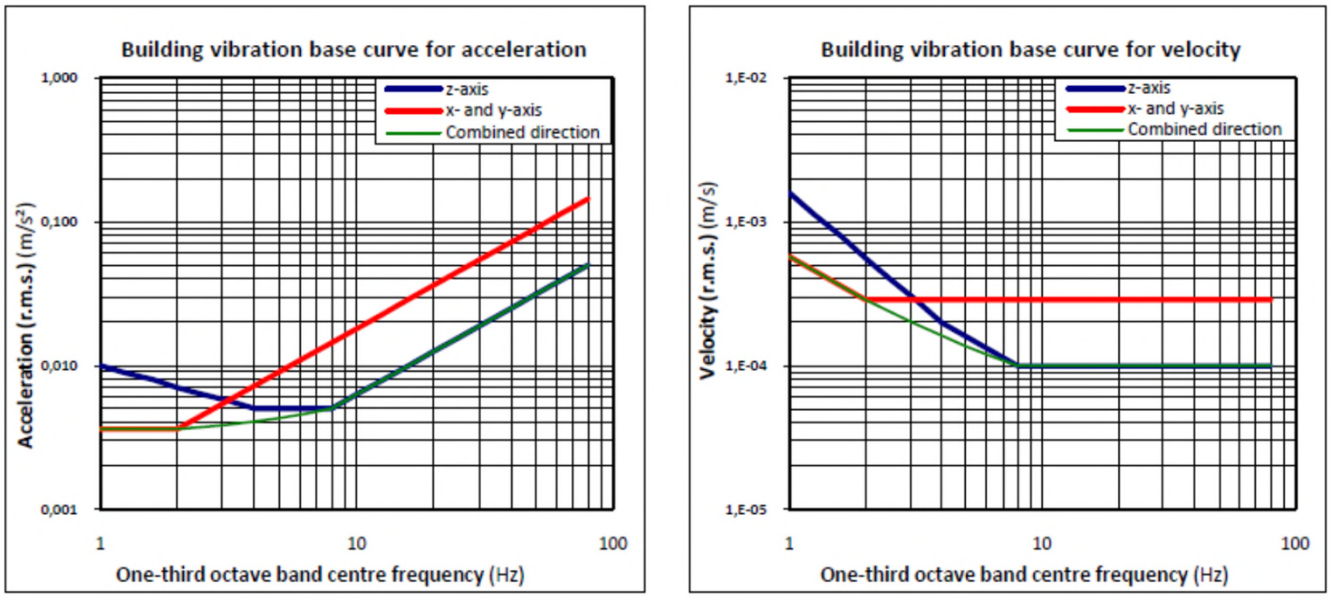

Figure 1.1 Building vibration base curves of ISO 2631-2:1989

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Impact on humans

- Alterations of sleep rhythm and sleep depth are reported already at 0.4 mm/s rms (frequency weighted) and cardiovascular reactions are reported from 0.3 mm/s rms (frequency weighted)
- Noticeable increase in vibration levels differ from 10% up to 40% in rms between different studies
- There are a lot of differences between people and also a lot depends on surrounding factors
- Health impact is not known

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Annoyance

- Very few studies have been done concerning railway vibration annoyance compared to studies for noise
- Some annoyance may occur already at the threshold of perception 0.1 mm/s rms but it is more likely at a level of 0.4 mm/s rms that annoyance will start to occur
- There are a lot of differences between people and also a lot depends on surrounding factors

Complaints

- Can occur beside existing, modified or new infrastructure
- Record and monitor complaints are important
- Explain difference between noise (audible) and vibration (perceivable as trembling), and possibly additional noise from pottery (rattling)
- Explain - very low risk of damage to buildings and other constructions
- Only if high amplitudes are expected (buildings close to track, soft ground, heavy traffic) - indicative measurement
- Only if legally obliged - interpret measurement result and decide about detailed assessment and possibly mitigation measures

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Legal obligations

- Very few countries with legal vibration limits
- In many countries assessment is required for new lines and significant rebuilt lines
- In some countries assessment is required for increase in traffic volume, train speed, train type or axle loads
- In many countries assessment is required when new buildings are planned close to railways

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Standards and descriptors

Quantity	reference	symbol	unit
rms weighted acceleration		a_{eff}	m/s^2
rms vibration velocity		v_{eff}	m/s
maximum rms vibration velocity		$v_{eff,max}$	m/s
maximum rms vibration velocity level		VdB	dB
Vibration dose value	BS6472	VDV	$m/s^{1.75}$
Particle velocity	BS7385	pvth	m/s
Maximum transient vibration value (running rms)	ISO 2631		
Vibration dose value	ISO 2631	VDV	$m/s^{1.75}$
Maximum acceleration	Ö Norm S 9012	E_{max}	m/s^2
Risk of exceeding a limit value by 5%	NS 8176	$V_{w,95}$	mm/s
Mean equivalent acceleration	Ö Norm S 9012	E_r	m/s^2
Maximum weighted rms acceleration level	UNI 9614	L_{aW}	dB re 10^{-6} m/s^2
Maximum weighted rms velocity level	SS 460 4861	L_{vW}	mm/s
Maximum weighted vibration strength	DIN 4150	KB_{Fmax}	-
Mean vibration strength	DIN 4150	KB_{FTr}	-

Key points

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Challenge to inform the public!

- Very few cases of only minor damage – risk is close to zero
- Threshold of perception is low – humans are sensitive
- Annoyance and health impact are not fully known
- A lot of differences between countries concerning descriptors
- What about measurements and mitigation measures?

Thank you for your attention! Do you have any questions?