

BEFORE THE HEARINGS PANEL

UNDER THE

the Resource Management Act 1991

AND

IN THE MATTER OF

Plan Change 1 to the Partially
Operative Second Generation
Dunedin City District Plan 2024

IN THE MATTER OF

Submission 252 of Health New
Zealand Te Whatu Ora

**EVIDENCE OF BRENDON SHANKS ON BEHALF OF HEALTH NEW
ZEALAND TE WHATU ORA**

Submitter #252 on Plan Change 1

Acoustics

Dated: 1 August 2025

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1 SUMMARY OF EVIDENCE

- 1.1 Health New Zealand Te Whatu Ora (**Health NZ**) and Marshall Day Acoustics oppose the proposed construction site investigation vibration rule 4.5.4.X (the **Proposed Rule**) in the notified Plan Change 1 (**PC1**) to the Partially Operative Dunedin City Second Generation District Plan (**2GP**).
- 1.2 I agree that a change to the existing vibration limits in the 2GP is required because those limits are too permissive and allow potentially unreasonable levels of vibration. I also agree that it is appropriate to set different limits for managing effects of vibration on amenity and building damage. Recommending two different sets of limits acknowledges that there is a significant difference between the onset of these potential effects.
- 1.3 The Proposed Rule has, however, removed the distinction between the protection of amenity, and addressing risk of cosmetic building damage. It has instead applied the amenity limits recommended by Styles Group to building damage (**Styles Report**),¹ rather than applying the building damage limits derived from the German Standard, as recommended in the Styles Report. I consider that this is inappropriate and will result in more resource consents being required for construction and site investigation activities than is necessary.
- 1.4 Mr Dale and I have drafted a replacement rule, included as Appendix A, which reinstates the distinction between amenity and building damage, and which includes other amendments to provide more flexibility in the application of amenity limits in certain circumstances to reflect the temporary nature of construction activities (**Replacement Rule**). In my opinion, the Replacement Rule enables a more proportionate response to the potential effects of vibration from construction activities.
- 1.5 The S42A Report has recommended changes to the Proposed Rule which largely address my concerns. I remain of the opinion however that the way in which the recommendations in the section 42A report have attempted to simplify the reference to the guideline values in the German Standard for building damage is not appropriate. In my opinion,

¹ Included as part of the section 32 report.

those simplifications introduce greater uncertainty, and I consider that the reference to that Standard should be included in the Proposed Rule without modification, as proposed in the Replacement Rule.

2 INTRODUCTION

Qualifications and Expertise

- 2.1 My name is Brendon John Shanks and I am an Associate at Marshall Day Acoustics, based in Dunedin. I have worked at Marshall Day since 2007, with a four year gap working in the UK for another acoustic consultancy.
- 2.2 I hold the qualifications of degrees of Bachelor of Science and Bachelor of Music from the University of Otago. I am a member of the Acoustical Society of New Zealand and the Institute of Acoustics (UK). I have 17 years' experience, specialising in acoustics and vibration. Throughout this time, I have predicted, measured, and assessed vibration for projects throughout New Zealand and the UK.
- 2.3 My experience includes a large number of construction vibration assessments for residential sites in Auckland, where vibration was a key issue in the consenting process.
- 2.4 I have been engaged by Health NZ in respect of its submission on PC1 to the 2GP.
- 2.5 I, on behalf of Marshall Day Acoustics, also lodged a submission on PC1 to the 2GP (**MDA Submission**), discussed further below.² Given the alignment between Health NZ's submission and the MDA Submission, I am now providing acoustic expertise on behalf of Health NZ.

3 CODE OF CONDUCT

- 3.1 While this is not an Environment Court proceeding, I confirm that I have read the Code of Conduct for Expert Witnesses set out in the Environment Court Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and will continue to comply with it while giving oral evidence. Except where I state that I am relying on the expertise of another person, this written evidence is within my area of

² Submitter #302.

expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

4 SCOPE OF EVIDENCE

4.1 This evidence is presented on behalf of Health NZ and relates to vibration matters associated with Health NZ's interest in PC1. In summary, it:

- (a) addresses the changes to construction vibration limits proposed by the Dunedin City Council (**DCC**) as part of PC1;
- (b) addresses the relevant technical elements of the section 42A report (**S42A Report**); and
- (c) provides recommended changes to the vibration rule as part of PC1.

4.2 In preparing my evidence, I have reviewed:

- (a) PC1 as it relates to changes to the management of construction vibration and noise, including the Proposed Rule.
- (b) The section 32 report for PC1, dated 20 November 2024 (**S32 Report**).
- (c) The Styles Report.³
- (d) German Standard DIN 4150-3:2016 (**German Standard**).
- (e) British Standard BS 5228-2:2009 (**British Standard**).
- (f) International Standard ISO 4866:2010 (**ISO Standard**).

5 PC1 - CONSTRUCTION VIBRATION LIMITS

5.1 I agree with the comments in the S32 Report that a change to the existing vibration limits in the 2GP is required because they are too permissive and allow potentially unreasonable levels of vibration.

³ Styles Group, *Dunedin City Council Second Generation District Plan – Variation 3 – Evidence on Construction Noise and Vibration*, 5 May 2023, S32 Report, at Appendix C.6 (**Styles Report**).

5.2 The Proposed Rule in PC1 is:

4.5.4.X

- a. *Construction and site investigation received at buildings or scheduled heritage structures in any zone must not exceed the following vibration limits:*

Location	Time period	Vibration limit (mm/s PPV)
<i>A building housing a noise sensitive activity</i>	<i>i. 7.00am - 10.00pm</i>	<i>2.0</i>
	<i>ii. 10.00pm - 7.00am</i>	<i>0.3</i>
<i>All other buildings and scheduled heritage structures</i>	<i>iii. At all times</i>	<i>2.0</i>

...

- c. *Activities that contravene this performance standard by less than 3.0mm/s PPV are discretionary activities.*
- d. *Activities that contravene this performance standard by 3.0mm/s PPV or more are non-complying activities.*

5.3 According to the S32 Report, the Proposed Rule adopts Option 4 outlined in the Styles Report, but that Option has been simplified “to avoid unnecessary technical complexity, keep the standard clear to Plan users, and support effective implementation”.

5.4 Consequently, the Proposed Rule has removed the distinction between the protection of amenity, and addressing risk of cosmetic building damage. It has instead applied the amenity limits recommended by Styles Group to building damage, rather than applying the building damage limits derived from the German Standard, as recommended in the Styles Report.⁴

5.5 Non-compliance with those limits would trigger the requirement for resource consent as a discretionary activity and non-complying activity

⁴ Styles Report, at [3.3.1] - [3.3.4].

statuses. As discussed further below, in some instances, the use of rigid limits as proposed would discourage adopting a best practicable option (**BPO**) approach, as required by section 16 of the Resource Management Act (**RMA**), e.g. where a construction method generates more vibration but would occur over a shorter timeframe. For that reason and those reasons set out in the MDA Submission and this evidence, I do not consider that that approach (and therefore, the Proposed Rule as currently drafted) is appropriate.

6 MDA SUBMISSION

6.1 The MDA Submission sought, as primary relief, to reject both the proposed removal of rule 4.5.4.1.b from the 2GP and the addition of the Proposed Rule. The reasons for that submission were:

- (a) The proposed vibration limits in the Proposed Rule are very strict and are not based on any known vibration standard.
- (b) It is unclear whether the proposed vibration limits in the Proposed Rule are intended to address cosmetic building damage or vibration amenity effects.
- (c) The most commonly used cosmetic building damage standard, the German Standard, provides much more permissive limits than the vibration limits in the Proposed Rule and are appropriate for different building types.
- (d) In urban and suburban environments, vibration amenity limits are likely to be often exceeded by small-scale construction activity for which there is no practical alternative to lower vibration levels. Rather than applying the limits rigidly, it is preferable to prioritise a management approach to amenity effects, alongside appropriate limits to address the risk of building damage (i.e. the German Standard).

6.2 Health NZ filed a further submission in support of the MDA Submission.

7 DISCUSSION ON VIBRATION LIMITS

Styles Report and the S32 Report

- 7.1 The Styles Report sets out four options for vibration limits.⁵ All of these options include separate limits for vibration amenity and cosmetic building damage. In summary, the four options all set a vibration amenity limit of 2mm/s peak particle velocity (**PPV**) at occupied buildings, with a lower limit of 0.3 mm/s PPV at night in occupied buildings housing an “activity sensitive to noise”. All of the options also recommend that the thresholds in the German Standard are adopted as limits to address potential building damage.
- 7.2 Recommending two different sets of limits (amenity and building damage) acknowledges that there is a significant difference between the onset of these potential effects. Consequently, the recommended options state that the amenity limits should only apply to occupied buildings, since they are designed to address effects on people.⁶ As discussed further below, I support that approach and consider that Option 2 identified in the Styles Report would, with some minor refinements, be the most suitable method for managing the effects of construction vibration.
- 7.3 The importance of those variables which influence vibration appear to be acknowledged in the S32 Report, which states that:⁷

"Potential effects of vibration on amenity and health and safety depend on the level of vibration, the time of day that the vibration occurs, the frequency of the vibration, whether the vibration is steady and continuous or transient and intermittent, how often it occurs, its total duration, and the construction and sensitivity of receiving buildings (including whether they have significant heritage values). As such, assessment criteria should require this information to be provided with applications."

- 7.4 Despite that acknowledgment however, the vibration limits in the Proposed Rule are proposed to apply to all buildings, regardless of the duration of the activity, the type of building, or if the buildings are even

⁵ Styles Report, at [3.3.1] - [3.3.4].

⁶ Styles Report, at [3.3.1] - [3.3.4].

⁷ S32 Report, at [605].

occupied. In other words, the Proposed Rule does not enable any of the variables mentioned in the S32 Report statement to be accounted for.

7.5 There are a number of adverse consequences to the way in which the S32 Report has simplified the approach recommended in the Styles Report:

- (a) The Proposed Rule does not provide sufficient flexibility to manage vibration effects, including enabling the adoption of the BPO. This will invariably increase the number of resource consents that will be required, as it is highly likely that the proposed limits would be regularly exceeded. As discussed further below, I do not consider that the way in which those limits are set out in the Proposed Rule are reasonable or appropriate for addressing construction vibration.
- (b) By applying amenity limits to buildings which are not occupied, the Proposed Rule removes one of the key management tools that enables activity to occur, i.e. consultation to undertake work when buildings are not occupied. In some cases, this will result in amenity limits being enforced at buildings that are never (or very rarely) occupied e.g. at a pump house, or a residential garage etc. There is no reasonable justification for applying an amenity limit to buildings that are unoccupied, given the purpose of that limit is to address the effects of vibration on people.

7.6 I address the limits for amenity and building damage in further detail below.

Amenity limits

7.7 The proposed daytime amenity limit of 2mm/s PPV is recommended in the Styles Report as a threshold for where vibration is likely to be “clearly felt and noticeable.”⁸ Styles Group acknowledges that this threshold is based on their own descriptions, not on guidance from any vibration standard. I agree that 2mm/s PPV would be clearly felt and noticeable in most situations. However, this does not make it an unreasonable level of vibration from construction and site investigation.

⁸ Styles Report, at page 9.

- 7.8 It is generally acknowledged that effects from construction activities can be higher on the basis that they are temporary and, by their nature, more difficult to mitigate than typical operational vibration sources. Just because vibration is clearly felt and noticeable does not make it an appropriate limit, particularly if the occupants have been informed of the activity in advance.
- 7.9 The construction noise limits provide a useful precedent where greater effects are considered appropriate to enable temporary activities. The daytime noise limits for construction are 15-25 decibels higher than the normal residential noise limits (depending on the duration of construction). The level of noise allowed from construction activities is much higher than would be considered acceptable for typical non-temporary activities. A similar rationale should be applied to vibration from construction activities.
- 7.10 Because the Proposed Rule adopts a vibration limit of 2mm/s PPV with few exceptions or scope for flexibility, those limits in the Proposed Rule would be exceeded by a number of typical earthworks/construction activities if they are conducted within 10m of another building. As a result, a resource consent would be required for basic earthworks activities on many residential sites.
- 7.11 This has been the case in Auckland where a 2mm/s PPV vibration amenity limit was adopted in the Auckland Unitary Plan, with similarly limited flexibility or exception.⁹ This has resulted in large numbers of resource consents being required for typical, relatively small scale, earthworks in urban areas where that limit was exceeded. The rule has since been relaxed to allow the limit to be exceeded for up to 3 days to allow some minor activities to occur. In many cases, Auckland Council has been accepting the application of amenity limits as a trigger for management and mitigation measures (e.g. a construction vibration management plan) through the resource consent process.
- 7.12 In principle, I consider that amenity criteria should be used as a threshold for the onset of management and mitigation measures, rather than a rigid limit, and in my opinion, those measures could be applied without triggering the requirement for resource consent. I accept,

⁹ Auckland Unitary Plan, Table E25.6.30.1 Vibration limits in buildings

however, that for clarity and efficient administration of the 2GP, a limit threshold may be more appropriate. If an amenity limit (for example, 2mm/s PPV) is used however, it is critical that the rule includes flexibility, such as an allowance for short term exceedances to allow the BPO to be adopted. I also consider that the amenity limit should only apply to buildings which are occupied.

- 7.13 Of the options proposed in the Styles Report, Option 2 best reflects that approach in my opinion. As discussed further below, my recommended rule is based on that Option, but includes some amendments that I consider are necessary in relation to the measurement location.

Building damage limits

- 7.14 The German Standard groups buildings into categories to acknowledge that some types are more susceptible to cosmetic damage than others. It then ascribes specific guideline vibration values to those categories, with lower values where the category is more susceptible to building damage, and higher values where the building category has greater resilience.
- 7.15 The German Standard states that minor damage due to vibration will be avoided if its guideline values are complied with. It also states that exceeding the guideline values does not necessarily lead to damage, but further investigations may be necessary.¹⁰ In that regard, the German Standard enables a more targeted BPO approach to managing vibration effects on buildings.
- 7.16 The DCC has attempted to simplify the recommended options provided by the Styles Report (which adopt the German Standard approach) and, in doing so, the Proposed Rule uses a limit that is more stringent than the German Standard for all buildings. As I have stated, that simplification results in a rule which is unnecessarily restrictive in terms of addressing the effects of vibration on buildings. It also fails to acknowledge the different levels of susceptibility that buildings may have to vibration. I therefore support Option 2 of the Styles Report, which identifies that the applicable vibration limit for building damage is the guideline PPV values set out in the German Standard.

¹⁰ German Standard, at section 4.2.

Measurement of vibration

- 7.17 When measuring and assessing vibration it is important to consider what effect the measurements are addressing, whether it be building damage or amenity. This will determine which measurement methodology (e.g. location) is appropriate.
- 7.18 The Proposed Rule states that "*PPV will be measured in accordance with the International Standard ISO-4866:2010 Mechanical vibration and shock*".¹¹ This appears to have come from a reference in the Styles Reports which incorrectly states that peak particle velocity (PPV) is defined in the ISO Standard.¹² The Proposed Rule also states that vibration for both amenity and building damage is to be measured at the following locations, closest to the source of the vibration:
- (a) for multistorey buildings, in the corner of the floor of each storey; and
 - (b) for single storey buildings and for scheduled heritage structures, at the foundation, within 500mm of existing ground level.
- 7.19 Option 2 in the Styles Report also adopts these locations for measuring vibration effects – but only in relation to amenity. For building damage, it references the German Standard.

Measurement for amenity

- 7.20 I support the Option 2 approach, with some minor amendments. For the reasons set out below, it is not appropriate to use the same measurement location for assessing vibration effects on amenity in order to assess vibration effects on building damage.
- 7.21 The ISO Standard provides general guidance on the appropriate measurement location for assessing vibration against specific amenity criteria. This standard refers to specific motions that may be at mid-span locations¹³ (i.e. vibration that would be felt by a person if they are located near the centre of a floor slab span, rather than close to structural elements such as a beam or the slab edge). Mid-span positions

¹¹ Plan Change 1 to the 2GP, rule 4.5.4.X.b.i.

¹² Styles Report, at [3.3.1] - [3.3.4].

¹³ ISO Standard, at section 9.1.2.

are usually unrelated to structural integrity and should not be used to assess building damage.¹⁴ They are, however, appropriate measurement locations for measuring effects of vibration on amenity.

7.22 Calculating vibration levels at this mid-span position requires detailed knowledge of the building foundation and floor resonance, which is not practical for all nearby receivers. It is more practical to calculate the vibration level in the ground at the closest part of the building and assume neutral losses/amplification due to the building foundation and/or suspended floors. In most instances the vibration received within the building will be less than the vibration level in the ground outside. In some cases however, floor resonances will result in amplification at the measurement position.

7.23 To account for those constraints, I consider that, in relation to effects on amenity, vibration should be calculated and assessed in the ground outside a receiving building, but measured in accordance with the ISO Standard at a position that is representative of a receiver's typical position in the relevant room or building. My recommended Replacement Rule reflects that approach, which is a minor change from what was recommended by Styles for Option 2.

Measurement for building damage

7.24 The German Standard provides a measurement procedure that is suitable for assessing building damage and relates to limits contained in that Standard. This includes measurement positions at appropriate parts of the building structure to assess building damage.

7.25 I consider that it is appropriate to require that vibration is measured and assessed in accordance with the German Standard, along with the guidance PPV values from that Standard, when considering potential building damage. In that regard, I support the approach taken in Option 2 of the Styles Report.

¹⁴ ISO Standard, at section 9.1.2.

8 REPLACEMENT RULE - RECOMMENDED APPROACH

8.1 In **Appendix A** of my evidence, I have drafted a Replacement Rule for the Proposed Rule which is based on Option 2 of the Styles Report, but includes amendments relating to the measurement location. In summary, that rule:

- (a) distinguishes between vibration amenity limits and building damage limits, noting that vibration amenity should only be assessed in occupied buildings on another site;
- (b) provides flexibility to exceed amenity limits for a short duration;
- (c) adopts the building damage guidance values and associated measurement and assessment methods contained in the German Standard (including different limits for different building types); and
- (d) sets appropriate calculation and measurement locations for assessing effects of vibration on amenity.

8.2 If the amenity limits are exceeded (and those exceedances not otherwise exempted), that would trigger the requirement for resource consent as a restricted discretionary activity. That would enable consideration of management measures, e.g. submission and certification of a construction vibration management plan and communication with occupants of buildings where vibration is predicted to exceed that threshold.

8.3 If the guidance PPV values for building damage set out in the German Standard are exceeded, then in accordance with that Standard a more detailed assessment would be required, including more significant management measures such as pre-construction building condition surveys and vibration monitoring during construction.

9 S42A REPORT

9.1 I have reviewed the relevant sections of the S42A Report and the Acoustic and Vibration Evidence provided by Mr Jamie Exeter of Styles Group (**S42A Evidence**).¹⁵ Both of these documents recommend

¹⁵ Appendix C.6 of the S42A Report.

changes to the Proposed Rule that address the main concerns I have outlined in my evidence.

9.2 The S42A Report and Mr Exeter both recommend that:

- (a) separate limits for vibration amenity and building damage are included in the Proposed Rule;
- (b) the German Standard should form the basis for building damage limits; and
- (c) amenity limits should only apply to occupied buildings.¹⁶

9.3 I note that the S42A Report author has incorrectly stated in that Report that the German Standard includes limits relating to amenity effects.¹⁷ The German Standard only considers guidance for the onset of cosmetic building damage. The amenity criteria proposed in the Rule do not relate directly to any standard.

9.4 I agree with the recommendation in the S42A Report to reintroduce an allowance to exceed the vibration amenity limits for up to three days.¹⁸ This approach is also supported by Mr Exeter.

9.5 The S42A Report recommends that exceeding the performance standard should not trigger a non-complying activity status, except in situations where a noise sensitive activity is affected at night or where vibration may seriously impact heritage buildings and structures.¹⁹ I agree with this approach. However, I consider that an exemption may be required for night-time works in the road corridor that are required for traffic management reasons. I note that a similar exemption is included in the Auckland Unitary Plan.²⁰

Assessment of changes to vibration limits

9.6 The S42A Report recommends amendments to the building damage limits in the Proposed Rule to simplify the guideline vibration levels

¹⁶ At page 4 of the S42A Evidence Mr Exeter similarly notes that the limits in the Proposed Rule are too low to be used as controls for building damage.

¹⁷ S42A Report, at page 211.

¹⁸ See 4.5.4.X.a.iv.2.

¹⁹ See S42A Report, at page 216.

²⁰ Auckland Unitary Plan, E25.6.29 Construction noise and vibration levels for work within the road, (4A).

outlined in the German Standard.²¹ In my opinion, the attempted simplification introduces greater uncertainty.

9.7 The German Standard provides guidance vibration levels for two types of vibration sources:

(a) **Short-term vibration:** defined as “*vibration that does **not** occur often enough to cause material fatigue and whose development over time and duration is **not** suitable for producing a significant increase in vibration due to resonance in the particular structure.*”²²

(b) **Long-term vibration:** defined as “*any type of vibration not covered by the definition of ‘Short-term vibration’.*”²³

9.8 The phrases “long-term” and “short-term” can be misleading, as long-term, by that definition, may apply to a vibration source that only lasts for a few seconds. Most sources of vibration used in construction have the potential to produce a resonance in a structure through repetitive vibration, and would be accordingly be considered “long-term” vibrations based on this definition. Notable exceptions include impact piling and blasting.

9.9 The relevant limits in the Proposed Rule, as recommended in the S42A Report,²⁴ incorporate the German Standard limits for short-term vibration from 1 Hertz (Hz) – 10Hz.²⁵ These limits are a simplification of the full guideline values from the German Standard, which provides different values for frequencies up to 100Hz. The frequency-dependent values of the German Standard reflect the lower risk of building damage at higher frequencies. Removing this part of the Standard sets a lower threshold than necessary for any transient vibration sources above 10Hz.

9.10 The S42A Report attempts to address this by saying that “*if the limits in the table are exceeded and consent is triggered, more detailed assessment in relation to frequency can be undertaken as the new*

²¹ In particular, at 4.5.4.X.b.

²² German Standard, at section 3.5.

²³ German Standard, at section 3.6

²⁴ Rule 4.5.4.X.b, see S42A Report, at page 219.

²⁵ See the column headed ‘Vibration limit (mm/s PPV)’.

assessment rules reference the [German Standard].”²⁶ This would, however, result in an unnecessary consent process for a non-complying activity for short-term vibration sources with a dominant frequency over 10Hz, even where they comply with the guidelines in the German Standard e.g. a source generating 10mm/s PPV at 60Hz at a dwelling.

9.11 Figure 1 below is taken from the German Standard. This is a graphical representation of the short-term vibration limits in the German Standard, with PPV on the vertical axis and frequency on the horizontal axis. I have circled the simplified limits recommended in the S42A Report in green and marked the graph to show areas in red where vibration would comply with the German Standard, but would trigger a consent process under the limits proposed in the S42A Report. I have also included the example short-term vibration source used above. The three lines correspond to the three limits in the Proposed Rule relating to Least Sensitive, Moderately Sensitive, and Vibration Sensitive structures.²⁷

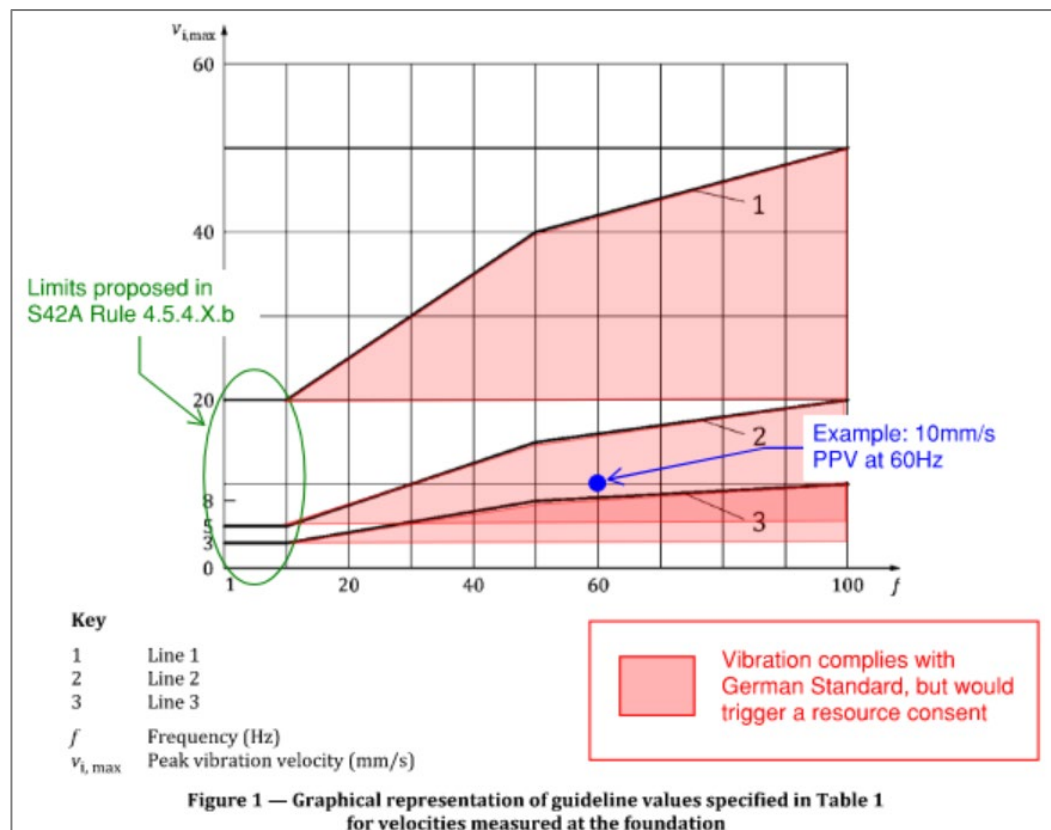


Figure 1

²⁶ S42A Report, at page 217.

²⁷ I.e. 4.5.4.X.b.i, ii and iii.

- 9.12 The table in the Proposed Rule includes the German Standard limits for long-term vibration (second column of limits).²⁸ The S42A Report author has included a note beneath the table suggesting that the limits in the Proposed Rule may not protect structures from cosmetic damage from long-term vibration (as defined in the German Standard), and that even lower limits may be required for “larger longer duration projects”.²⁹
- 9.13 However, the table in the Proposed Rule already includes the long-term vibration values from the German Standard which are designed to protect buildings from this type of vibration. The German Standard states that “*Experience shows that no damage due to vibration adversely affecting serviceability will occur if these guideline values are complied with.*”³⁰
- 9.14 Based on this, I disagree that the limits would not protect against building damage for those additional vibration sources and that lower limits may be required in those instances.
- 9.15 I agree with Mr Exeter and the S42A Report author that the German Standard is the most appropriate performance standard for protecting against building damage. This Standard has been successfully implemented in the Auckland Unitary Plan and by numerous other local authorities. The attempts that have been made to simplify the German Standard have resulted in inappropriate criteria that create greater uncertainty and potential for unnecessary consents. I recommend that the building damage limits in the Proposed Rule reference the German Standard without modification.

10 CONCLUSION

- 10.1 I consider that the Proposed Rule is not fit for purpose, as it would result in a significant number of exceedances for typical construction activities with reasonable vibration effects. Examples of similar vibration rules have resulted in a considerable number of resource consents being required and have ultimately led to the rules being treated as a threshold for practical management measures.

²⁸ See the column headed ‘Vibration limit for increased vibration due to resonance in the structure or where vibration occurs often enough to cause material fatigue (mm/s PPV)’.

²⁹ S42A Report, at page 20.

³⁰ German Standard, at section 4.2.

- 10.2 I consider that an amenity threshold that triggers management measures, but does not require a resource consent is the BPO for managing effects. However, if two different sets of limits (amenity and building damage) are to be included, I recommend a vibration amenity limit of 2mm/s PPV at occupied buildings with flexibility to exceed the limits for short periods. Longer exceedances should be considered a restricted discretionary activity.
- 10.3 The recommendations contained in the S42A Report largely address these issues. However, the limits for cosmetic building damage should be based on those in the German Standard, without attempting to “simplify” them.

Brendon Shanks
1 August 2025

APPENDIX A – REPLACEMENT RULE

4.5.4.X Construction and Site Investigation Vibration

- (a) Construction and site investigation vibration received at occupied buildings in any zone must not exceed the following amenity vibration limits:

Location	Time Period	Vibration Limit (mm/s PPV)	Measurement Location
A building housing a noise sensitive activity	7.00am to 10.00pm	2 mm/s PPV	Measurement location: On the floor at a mid-span location that represents an occupant's typical position in the room, in accordance with International Standard ISO 4866:2010. Calculation location: In the ground at the closest part of the building.
	10.00pm to 7.00am	0.3 mm/s PPV	
All other buildings	At all times	2 mm/s PPV	

- (i) Except that this standard does not apply to:

1. Vibration received at a building on the same site as the construction and site investigation activity where the building and land on which the construction and site investigation activity is undertaken are in the same ownership; or
2. Vibration from construction and site investigation activity undertaken within a road between the hours of 10.00am to 7.00pm; or
3. Vibration that complies with a limit of 5 mm/s PPV unless a lower limit for avoiding building damage in rule 4.5.4.X(b) applies, in which case the lower limit must be complied with; and
4. The vibration occurs on a total of no more than three days per construction project and only between the hours of 7.00am and 6.00pm; and
5. The occupants of all buildings are advised in writing no less than three days before the vibration-generating construction and site investigation works begin. The written advice must include the location and duration of the works, and a contact name and phone number for questions or complaints.

- (b) Construction and site investigation vibration received at any buildings in any zone must not exceed the following building damage vibration limits:

Location	Time Period	Vibration Limit (mm/s PPV)	Measurement Location
Any building	At all times	The guideline vibration velocity values (PPV) set out in the German Standard DIN4150-3:2016 <i>Vibration</i>	In accordance with the requirements of DIN4150-3:2016

		<i>in buildings – Part 3: Effects on Structures.</i>	
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- (i) Except that this standard does apply to vibration received at a building on the same site as the construction and site investigation activity, provided the building is not a scheduled heritage building, and the building and land on which the construction and site investigation activity is undertaken are in the same ownership.
- (c) Activities that contravene performance standard (a) or (b) above are restricted discretionary activities.

Rule 4.8 Assessment of Restricted Discretionary Activities

4.8.2 Assessment of restricted discretionary activities			
Activity		Matters of discretion	Guidance on the assessment of resource consents
1			
2	Construction and site investigation vibration	a. Effects on amenity. b. Effects on health and safety.	Relevant objectives and policies: a. Objective 4.2.1.1 Temporary activities are designed and operated in a way that minimises, as far as practicable, effects on: i. the amenity of surrounding properties; and ii. people's health and safety (Policy 4.2.1.1.a and b). Relevant guidance from other sections (priority considerations): b. See Section 13.7 for guidance on the assessment of resource consents in relation to Objective 13.2.1 and effects related to significant heritage values. General assessment guidance: c. In assessing the potential for vibration to cause building damage, resulting in effects on the amenity of surrounding properties, effects on public health and safety, or effects on significant heritage values, Council will consider whether the proposal is in accordance with German Standard DIN 4150–3:2016 Vibrations in Buildings - Part 3: Effects on Structures. d. The assessment will consider the proposed construction noise and vibration

			assessment and preliminary management plan submitted with the application (see Special Information Requirements - Rule 4.11.2).
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Rule 4.11 Special Information Requirements

4.11.2 Construction noise and vibration

1. For applications for contravention of the construction and site investigation noise performance standard (Rule 4.5.4.1) or vibration performance standard (Rule 4.5.4.X), the following information is required:
 - a. the methodology and sound power levels used to calculate the construction noise levels;
 - b. the worst-case and typical construction noise and vibration levels predicted at the most exposed façades of receiving buildings and structures in the surrounding environment;
 - c. a description of the potential effects and the level of disruption that is expected from the contraventions in the context of the overall project; the level, timing, frequency, duration, and character of the noise and vibration; the activities at receiving sites; and the existing ambient noise levels (where relevant); and
 - d. mitigation proposals for ensuring adverse effects on the amenity and character of the zone, people's health and safety are minimised as far as practicable.
2. For applications for contravention of the construction and site investigation noise performance standard (Rule 4.5.4.1) or vibration performance standard (Rule 4.5.4.X), Council may require a preliminary construction noise and vibration management plan prepared by a suitably qualified person that identifies the best practicable options to mitigate and minimise noise and vibration, and ensure the construction noise and vibration performance standards for the project are met. The management plan is to provide the following details:
 - a. a description of the general construction methodology, noise and vibration generating equipment to be used for the works, and the nearest neighbouring sites;
 - b. an assessment of the noise and vibration levels that will contravene the permitted standards, including the degree of the contravention, the time of day it will occur, how often, and over what duration;
 - c. the construction noise and vibration performance standards for the project;
 - d. a statement that all noise assessments have been undertaken in accordance with NZS 6803:1999;
 - e. for vibration that contravenes the building damage limits in Rule 4.5.4.X(b), an assessment of the potential for damage to receiving buildings or structures based on German Standard DIN 4150-3:2016, including whether scheduled heritage buildings or structures, or other buildings sensitive to vibration, are located within the receiving environment; and
 - f. the details of the proposed noise and vibration mitigation measures, including:

- i. physical measures such as acoustic barriers and shrouds, and any restrictions on plant size and operating distances;
- ii. management measures such as consultation with neighbours before and during the works, restrictions on timing for high-noise and vibration activities, procedures for responding to complaints, training of on-site personnel;
- iii. procedures for noise monitoring; and
- iv. for vibration:
 - 1. pre-construction condition surveys, vibration monitoring, and post-construction condition assessment processes for potentially affected buildings and structures (where appropriate); and
 - 2. procedures for construction vibration monitoring; and
 - 3. measures to mitigate vibration effects on scheduled heritage buildings and structures and other buildings sensitive to vibration.