



DUNEDIN CITY COUNCIL SECOND
GENERATION DISTRICT PLAN

VARIATION 3

EVIDENCE ON CONSTRUCTION NOISE AND VIBRATION

PREPARED FOR
Dunedin City Council

DATE
5 May 2023

Assessment prepared by Styles Group for Dunedin City Council.

REVISION HISTORY

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
2	5/05/23	Final updated to include further vibration options	Final	Jamie Exeter, MASNZ, Assoc. NZPI Principal Styles Group	Jon Styles, MASNZ Director and Principal Styles Group

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1.0 Introduction

Dunedin City Council (**DCC**) has engaged Styles Group to provide expert evidence on construction noise and vibration to inform Variation 3 of the Second Generation District Plan (the **2GP**).

DCC have sought advice to inform two potential changes to the existing 2GP construction noise and vibration provisions. These are the permitted standard for construction vibration and the permitted standard for construction noise.

This evidence has been prepared in accordance with the requirements of Section 9 *Code of conduct for expert witnesses* of the Environment Court of New Zealand Practice Note 2023.

The key personnel involved in preparing this evidence are:

- Jamie Exeter, MASNZ, Assoc.NZPI, Principal Consultant (author)
- Jon Styles, MASNZ, Director and Principal (reviewer).

Jamie and Jon both have significant experience in the measurement and assessment of construction noise and vibration. They both regularly undertake reviews of construction noise and vibration assessments on behalf of local government authorities throughout New Zealand. Jamie is currently writing a guideline document for the Association of Australasian Acoustics Consultants on the appropriate interpretation and application of the New Zealand construction noise standard NZS 6803:1999 *Acoustics – Construction Noise*. Jon has advised a considerable number of Councils throughout New Zealand in plan-making processes over the last 20 years. Further information on our qualifications, experience, and professional affiliations are available on request.

All options provided in this document have been made in accordance with the mandatory directions set out in Chapter 15 *Noise and Vibration Metrics Standard* of the National Planning Standards.

A glossary of acoustical terms used in this document is attached as Appendix A. Standards from other District Plans referenced in this document are provided in Appendix B.

2.0 Scope of evidence

The scope of our evidence regarding the 2GP construction noise and vibration standards is set out below:

2.1 Scope of construction vibration evidence

Required inputs:

- i. Provide advice in relation to the appropriateness of the construction vibration standard in the 2GP.
- ii. Provide an overview of the range of possible adverse effects that can arise from unacceptable levels of vibration, so that these can be built into appropriate objectives, policies, and assessment rules for when the vibration standard is contravened.
- iii. Provide options for a new construction vibration standard with an overview of the costs and benefits of each in terms of ensuring vibration effects are well-managed, referring to Chapter 15 of the National Planning Standards on requirements for noise and vibration metrics, and any relevant examples from other plans.

Not required:

- i. A review of vibration/air blast provisions for activities other than construction.
- ii. Advice on any new or amended objectives and policies required to support amended vibration rules, as this will be undertaken by DCC policy planners.
- iii. Recommendations on which of the options to adopt, as this will be undertaken by DCC policy planners.

2.2 Scope of construction noise evidence

Required inputs:

- i. Review the current noise limits for short-term and long-term duration construction in Rule 4.5.4.1.
- ii. Outline the reasonably practicable options to enable long-term construction projects to occur in built-up areas (e.g., commercial and mixed use zones such as the CBD Zone) while ensuring that adverse effects from construction noise are able to be managed, particularly in relation to aspects of large-scale construction projects that are likely to generate higher noise emissions (e.g. driving of piles). The options outlined should relate to Rule 4.5.4.1 and should provide examples of where this has been done in other jurisdictions, if available.
- iii. Provide construction noise limits that could be incorporated into Rule 4.5.4.1 for each option, where relevant, and/or details of technical information that should be considered as part of assessing resource consent applications, considering Chapter 15 of the National Planning Standards on requirements for noise and vibration metrics.

- iv. A preliminary assessment of the costs and benefits of each option in terms of managing the effects of construction noise.

Not required:

- i. Assessment of the costs and benefits of the options in terms of effects other than noise (e.g., in relation to enabling development anticipated by the Plan in built-up areas), as this will be undertaken by DCC policy planners.
- ii. Recommendations on which of the options to adopt, as this will be undertaken by DCC policy planners.

3.0 Vibration standard for construction

This section sets out our comments on the current construction vibration standard, advice on the potential adverse effects that can arise from unacceptable levels of vibration, and options for updated vibration standards.

3.1 Appropriateness of the 2GP construction vibration standard

The 2GP Standard for construction vibration is 4.5.4.1.b, which states:

Vibration from construction must not exceed a maximum particle velocity measured on any foundation of an adjacent building on another site, or the same site if different ownership, of 25mm/second for commercial buildings or 10mm/second for buildings housing noise sensitive activities.

Noise sensitive activities are defined by the 2GP as follows:

Activities where people are more likely to be sensitive to a high level of noise because they are sleeping, studying, seeking medical treatment, or engaged in religious activity.

These consist of:

- residential activities
- hospital
- campus
- schools
- early childhood education
- registered health practitioners
- visitor accommodation; and
- the following community and leisure activities: libraries, marae-related activities, activities that involve the provision of care for babies and pre-school children and places of worship.

There is no guidance provided on the status of an activity that contravenes the performance standard.

The relevant objectives and policies of the 2GP for vibration from construction (a temporary activity) are:

Objective 2.2.6

The risk to people's health and safety from contaminated sites, hazardous substances, and high levels of noise or emissions is minimised.

Policy 2.2.6.1

Protect people from noise, light or offensive emissions that may create adverse effects on health or well-being through rules that:

- e. Restrict the level of noise and light spill from activities and development to safe levels depending on the nature of the receiving environment (zone).

Objective 9.2.2

Land use, development and subdivision activities maintain or enhance people's health and safety.

Policy 9.2.2.1

Require activities to be designed and operated to avoid adverse effects from noise on the health of people or, where avoidance is not practicable, ensure any adverse effects would be insignificant.

Objective 4.2.1

Temporary activities are enabled while:

- a. minimising, as far as practicable, any adverse effects on the amenity and character of the zone; and
- b. ensuring any adverse effects on people's health and safety are minimised as far as practicable.

Policy 4.2.1.1

Require temporary activities to be designed and operated to minimise, as far as practicable, adverse effects on:

- a. the amenity of surrounding properties;
- b. people's health and safety; and
- c. the safety and efficiency of the transport network.

Limits for construction vibration are typically designed to avoid cosmetic building damage and to manage potential amenity and health effects on the occupants of buildings. Building damage is not specifically referenced in the relevant 2GP objectives and policies. We understand that construction vibration may be considered under the terms "emissions" and "noise" in Objective 2.2.6 and Policy 2.2.6.1. We note that the RMA definition of noise is "includes vibration".

The level of vibration at which cosmetic damage may occur within a building is in most cases¹ considerably higher than the levels where occupants of buildings may become annoyed and where noise sensitive activities and sleep may be disrupted.

The construction vibration limits of the 2GP are based only on the activity within the receiving building. There is no consideration given to the time of day, the nature or duration of the vibration, or the construction of the subject building.

The permitted standards are too permissive to provide certainty that cosmetic damage will not occur in buildings, and they enable levels of vibration that could cause significant disruption to noise sensitive activities during the daytime, and sleep disturbance at night. In our experience, the construction vibration limits in the 2GP should be amended to better manage adverse effects.

Brief and intermittent vibration events are common during construction works in built up areas. The potential effects of vibration on amenity are not only determined by the level of vibration. They also depend on 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, and its total duration. In our experience, assessment criteria should require this information to be provided with applications where the permitted standards for construction vibration cannot be complied with. An example of this is Auckland Unitary Plan (**AUP**) standard E25.8.2 *Assessment criteria*. We can provide recommendations for assessment criteria on request.

Rules for assessing infringements of construction vibration limits that are designed to avoid building damage should consider potential damage to the subject building, and that permission will need to be sought from the building owner to undertake any pre-condition surveys, vibration monitoring, and post-condition assessments.

3.2 Possible adverse vibration effects

This section discusses the potential effects of construction vibration on buildings and the occupants of buildings.

3.2.1 Potential effects of vibration on buildings

The response of a building to construction vibration is affected by factors such as the type of foundation, the building construction, and the state of repair of the building. It is therefore typical to assess potential construction vibration effects in terms of the nature of the receiving building and the frequency content of the vibration.

There is no New Zealand Standard for construction vibration. The two vibration standards commonly referenced for resource consent purposes are:

¹ Except for buildings that are in poor condition or otherwise very susceptible to the effects of vibration.

1. The British Standard BS 5228–2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*
2. The German Standard DIN 4150–3:2016 *Vibrations in buildings – Part 3: Effects on structures* (or the previous version published in 1999).

BS 5228–2:2009 provides guideline limits for transient vibration, above which cosmetic damage could occur. DIN 4150–3:2016 takes a different approach and provides guideline limits for transient vibration, below which cosmetic damage will not occur.

In our experience, the guidelines of BS 5228–2:2009 are more typically used for writing resource consent conditions after the potential effects of vibration and the associated risks have been considered based on site, building, and equipment specific assessments (and where there is a tolerance for risk of building damage).

The guideline values of DIN 4150–3 have been adopted as permitted standards in numerous District Plans² because compliance with these guidelines provides a high level of assurance that building damage will not occur. Examples of the type of building damage that the Standard considers are:

- The impairment of the stability of the building
- A reduction in the load-bearing capacity of floors and other components
- Cracks forming in plastered or rendered surfaces of walls
- Existing cracks in a structure being enlarged
- Partitions detaching from load-bearing walls or floor slabs.

DIN 4150–3:2016 states that the above examples of minor damage due to vibration will be avoided if its guideline values are complied with, and that it should be assumed that other causes are responsible if damage does occur in a building. Exceeding the guideline values does not necessarily lead to damage, but further investigations may be necessary.

The DIN 4150–3:2016 guideline values are based on a three-tiered classification system for buildings according to their susceptibility to vibration damage, as follows:

- Line 1: Buildings used for commercial purposes, industrial buildings, and buildings of similar design
- Line 2: Dwellings and buildings of similar design and/or occupancy
- Line 3: Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g., listed buildings under preservation order).

² For example, AUP standard E25.6.30 and Queenstown Lakes District Council Proposed District Plan standard 36.5.9

For example, commercial buildings are typically classified as Line 1. Residential dwellings are typically classified as Line 2 unless the receiving structure is particularly sensitive to vibration and of great intrinsic value. Line 3 is typically applied to heritage buildings, or other buildings identified by relevant experts as being particularly sensitive to vibration (e.g., due to pre-existing damage) and of great intrinsic value.

The guideline values provided by DIN 4150–3:2016 also depend on the dominant frequency of the vibration and whether the vibration is deemed “short-term” or “long-term”. Short-term vibration is defined by the Standard as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance (i.e., it is not a function of the duration of the construction project or the vibration it generates). Long-term vibration is all other types of vibration. Construction vibration within low-rise structures is commonly assessed against the short-term guidelines.

The DIN 4150–3:2016 frequency-dependent vibration values for short-term vibration are illustrated in Figure 1 for reference. Construction vibration is commonly observed at frequencies between 5 Hz and 50 Hz.

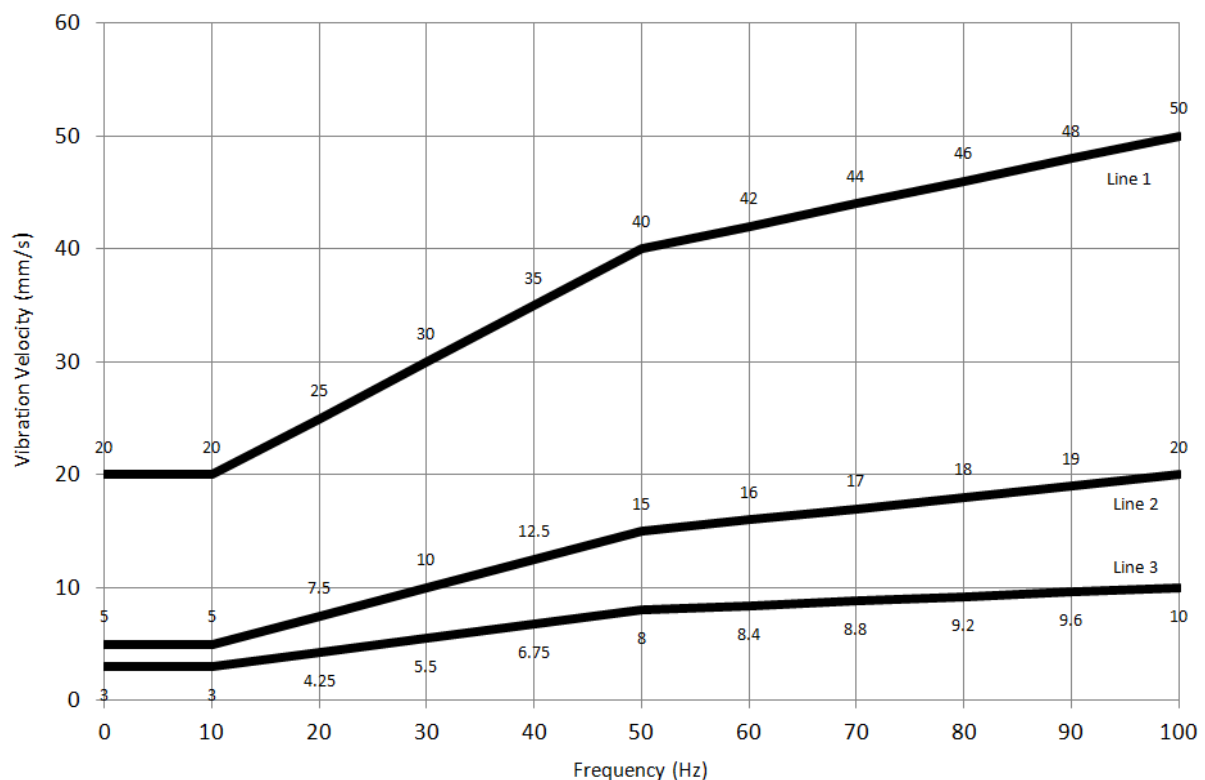


Figure 1: DIN 4150–3:2016 guideline values for short-term vibration

3.2.2 Potential effects of vibration on people

The threshold of perception of vibration for people within buildings during the day is typically 0.3 mm/s PPV, depending on their activity at the time. Perceptible vibration can cause sleep disturbance at night. Vibration exceeding 1 mm/s PPV during the day can disturb or startle people, cause annoyance, and interfere with work activities. Vibration at this level can cause structure-borne noise and can rattle loose fittings, which can generate additional annoyance for occupants of buildings. Vibration can also cause concern about potential building damage or effects on structural integrity. In our experience, the potential effects discussed above can be mitigated if the occupants of the building are expecting the vibration, and they have been informed that it will comply with a no-damage limit.

For reference, guidance on the effects of vibration levels from Table B.1 of BS 5228–2:2009 is displayed in Table 1.

Table 1: BS 5228–2:2009 guidance on effects of vibration

Vibration level (PPV)	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

We agree with the descriptions provided in BS 5228–2:2016. However, the standard leaves a large gap between vibration levels of 1 mm/s and 10 mm/s. This gap is significant and further comment may be helpful when considering the potential effects of construction vibration on the occupants of buildings. Table 2 displays our descriptions of construction vibration effects, including relevant levels between 1 mm/s and 10 mm/s.

Table 2: Description of potential construction vibration effects

Vibration level (PPV)	Potential effects on people
0.14 mm/s	Construction vibration may be just perceptible when people are stationary and there are no other sources of vibration.
0.3 mm/s	Construction vibration may be just-perceptible within a building. Vibration levels greater than 0.3 mm/s may cause sleep disturbance at night.

Vibration level (PPV)	Potential effects on people
1 mm/s – 2 mm/s	This level of construction vibration is noticeable in residential and office environments. It is generally tolerable, but complaint or adverse reaction is likely if there is no warning. Vibration at this level could rattle crockery, glassware, and loose fixtures and fittings. It will cause sleep disturbance at night for most people.
2 mm/s – 5 mm/s	Construction vibration levels between 2 mm/s and 5 mm/s are clearly felt and noticeable in residential and office environments. They can be tolerated where the vibration occurs intermittently during the day, and where the occupants have been informed that the vibration will be for a short duration and will not result in cosmetic building damage. The vibration is likely to shake computer screens and may rattle crockery, glassware, and loose fixtures and fittings. Light items could potentially move if the vibration is steady and close to 5 mm/s. The effects of vibration within this range (particularly) will depend on the nature of the vibration. For example, steady continuous vibration from a vibratory roller or vibratory piling will be more disruptive than occasional transient vibration at the same level from excavation works. This level of vibration will cause significant disturbance within dwellings at night and will prevent sleep for most people.
5 mm/s – 10 mm/s	This level of vibration is unlikely to be tolerated for longer than brief and intermittent exposures. It will be highly unsettling in residential settings and the workplace. If exposure was prolonged, people are likely to seek respite by leaving the building. Computer screens would shake, and light items could fall from shelves. Vibration greater than 5 mm/s is unlikely to be tenable for most places of work.
>10 mm/s	Vibration at this level is unlikely to be tolerated. Adverse reaction and complaint would be certain from most people in office and residential settings.

3.3 Options for vibration standards

This section provides options for a new construction vibration standard with an overview of the costs and benefits of each in terms of potential effects.

The numerical vibration limits used in these options are based on our description of effects displayed in Table 2 and consider the temporary nature of construction.

The recommended guideline vibration values in DIN 4150–3:2016 vary greatly depending on:

- The nature of the vibration i.e., whether it occurs often enough to cause material fatigue and whether its development over time will producing a significant increase in vibration due to resonance in the particular structure
- The dominant frequency of the measured vibration
- Where the vibration is measured from in the building

- The classification of the receiving building (as discussed in 3.2.1 of this evidence).

It is therefore necessary to either refer to the application of DIN 4150–3:2016 in full for the relevant limits and appropriate measurement locations when assessing vibration against its provisions or to ensure that these are appropriately specified in the rule. Construction vibration options 1 and 2 are based on referring to the Standard in full. Options 3 and 4 provide the same outcomes but they set out the requirements of DIN 4150–3:2016 in the rule.

3.3.1 Construction vibration option 1

Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed the following limits. The vibration limits for avoiding building damage apply at all times except where the building is occupied and the applicable vibration amenity limit is lower. Peak particle velocity (PPV) is defined in the International Standard ISO-4866:2010 *Mechanical vibration and shock*.

Vibration rule	Receiver	Period of application	Vibration limit	Measurement location
(i) Building damage	Any building not on the same site as the vibration generating activity	At all times unless a lower vibration amenity limit applies	The guideline vibration velocity values (PPV) set out in the German Industrial Standard DIN 4150-3:2016 <i>Vibration in buildings – Part 3: Effects on structures</i>	In accordance with the requirements of DIN 4150-3:2016
(ii) Amenity	Any occupied building housing an activity sensitive to noise	22:00 to 07:00	0.3 mm/s PPV	In the corner of the floor of the storey of interest for any occupied multi-storey building, or within 500 mm of ground level at the foundation of any occupied single storey building
		07:00 to 22:00	2.0 mm/s PPV	
	All other occupied buildings	At all times	2.0 mm/s PPV	

Option 1 provides set limits for avoiding building damage and for preventing unreasonable disruption to noise sensitive activities. The limits are based on the nature of the activity within the receiving building, and the time of day. The vibration amenity limits only apply at buildings that are occupied while the works are being undertaken and where they are lower than the limits prescribed to avoid building damage.

This option will provide a high degree of certainty that construction vibration will not result in building damage because it applies no-damage limits that can be complied with in most cases. Noise sensitive activities will not be unreasonably disrupted, but many medium to large scale construction projects would require consent for infringements of 2 mm/s. Construction works

typically involve the use of heavy machinery near to occupied buildings for short periods of time (e.g., during excavation, compaction, piling, and rock breaking). This can often generate intermittent vibration levels of up to 5 mm/s for short periods.

An assessment of the timing, frequency, duration, and nature of the vibration would be required to understand the potential effects on the occupants of buildings if an application proposes to infringe the vibration amenity standards of Option 1. This information could be required by assessment criteria.

3.3.2 Construction vibration option 2

Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed the following limits. The vibration limits for avoiding building damage apply at all times except where the building is occupied and the applicable vibration amenity limit is lower. Peak particle velocity (PPV) is defined in the International Standard ISO-4866:2010 *Mechanical vibration and shock*.

Vibration rule	Receiver	Period of application	Vibration limit	Measurement location
(i) Building damage	Any building not on the same site as the vibration generating activity	At all times unless a lower vibration amenity limit applies	The guideline vibration velocity values (PPV) set out in the German Industrial Standard DIN 4150-3:2016 <i>Vibration in buildings – Part 3: Effects on structures</i>	In accordance with the requirements of DIN 4150-3:2016
(ii) Amenity	Any occupied building housing an activity sensitive to noise	22:00 to 07:00	0.3 mm/s PPV	In the corner of the floor of the storey of interest for any occupied multi-storey building, or within 500 mm of ground level at the foundation of any occupied single storey building
		07:00 to 22:00	2.0 mm/s PPV	
	All other occupied buildings	At all times	2.0 mm/s PPV	

Construction vibration may exceed the amenity limits in the above table where:

- The exceedances occur on a total of no more than three days per project and only between the hours of 07:00 and 18:00, Monday to Saturday
- The vibration generated on these days complies with a limit of 5.0 mm/s PPV in any axis (unless a lower limit for avoiding building damage is prescribed by DIN 4150-3:2016, in which case the lower limit must be complied with)
- The occupants of all buildings where levels greater than 2.0 mm/s PPV are expected have been advised in writing no less than three days before the vibration-generating

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.

Option 2 provides the same high degree of certainty as Option 1 that construction vibration will not result in building damage, but it enables some common construction activities that are expected to exceed 2 mm/s in built up areas to be carried out under controlled conditions without requiring additional consent and without resulting in unreasonable disruption to noise sensitive activities.

The recommended 5 mm/s limit for three days is compliant with the no-damage vibration velocity values of DIN 4150-3:2016 at any frequency for dwellings and buildings of similar design (Line 2). If a building is identified by relevant experts as being particularly sensitive to vibration and of great intrinsic value (Line 3), this is a special case and the cosmetic building damage limits will take precedence over any higher amenity limits (as stated in the rule).

The additional effects on amenity of enabling vibration between 2 mm/s and 5 mm/s will be mitigated by limiting the timing, requiring consultation with the occupants, and limiting the duration to three days.

Consultation is very typically undertaken in the form of written advice that includes a contact name and number for questions and concerns. In most cases, the potential effects of construction vibration within buildings will be reduced where the occupants know when and for how long to expect it, and there are no concerns regarding building damage.

The suggested period of three days for higher vibration amenity limits is based on our experience in the assessment of construction vibration on the occupants of buildings. Vibration above 2 mm/s in buildings can be tolerated for short periods where there is prior consultation. However, people become less tolerant when this period is greater than approximately three days. The period for vibration levels greater than 2 mm/s in occupied buildings stated in a rule based on Option 2 could be longer than three days but this will result in greater effects on the building occupants. The likelihood that such effects will be tolerated by the occupants will depend on the factors that we have recommended as assessment criteria for construction vibration in Section 3.1.

A three-day period is often sufficient for small to medium construction projects to complete high vibration works near to occupied buildings. Vibration may still be generated outside of the three-day period but must comply with 2 mm/s. There are typically mitigation options available to achieve this, such as using smaller plant. In our experience, construction projects that will generate high levels of vibration for more than three days will typically also require consent in other areas.

An assessment of the timing, frequency, duration, and nature of the vibration would be required to understand the potential effects on the occupants of buildings if an application proposes to infringe the vibration amenity standards of Option 2. We recommend that this information is required by assessment criteria.

3.3.3 Construction vibration option 3

Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed the limits in (i) and (ii). The vibration limits for avoiding building damage apply at all times except where the building is occupied and the applicable vibration amenity limit is lower. Peak particle velocity (PPV) is defined in the International Standard ISO-4866:2010 *Mechanical vibration and shock*.

(i) Vibration amenity

Receiver	Period of application	Vibration limit	Measurement location
Any occupied building housing an activity sensitive to noise	22:00 to 07:00	0.3 mm/s PPV	In the corner of the floor of the storey of interest for any occupied multi-storey building, or within 500 mm of ground level at the foundation of any occupied single storey building
	07:00 to 22:00	2.0 mm/s PPV	
All other occupied buildings	At all times	2.0 mm/s PPV	

(ii) Building damage

Type of structure	Short-term vibration			Long-term vibration	
	Peak particle velocity in any axis at the building foundations when measured within 500 mm of the ground			Peak particle velocity at the topmost floor, horizontal direction, all frequencies	Peak particle velocity at the topmost floor, horizontal direction, all frequencies
	1-10 Hz	10- 50 Hz	50-100 Hz		
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20 mm/s	20-40 mm/s	40-50 mm/s	40 mm/s	10 mm/s
Residential buildings and buildings of similar design and/or occupancy	5 mm/s	5-15 mm/s	15-20 mm/s	15 mm/s	5 mm/s

Structures that are particularly sensitive to vibration and are of great intrinsic value	3 mm/s	3-8 mm/s	8-10 mm/s	8 mm/s	2.5 mm/s
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Short-term vibration means vibration that does not occur often enough to cause material fatigue, and its development over time and duration is not suitable for producing a significant increase in vibration due to resonance in the structure. Long-term vibration means any other type of vibration.

The PPV limit increases linearly over the frequency range where a range of vibration velocities is specified.

Vibration must be measured and assessed in accordance with DIN 4150-3:2016 *Vibration in buildings – Part 3: Effects on structures*.

Option 3 provides the same outcome as option 1 but sets out the requirements of DIN 4150–3:2016 in the rule instead of referring to the Standard.

3.3.4 Construction vibration option 4

Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed the limits in (i) and (ii). The vibration limits for avoiding building damage apply at all times except where the building is occupied and the applicable vibration amenity limit is lower. Peak particle velocity (PPV) is defined in the International Standard ISO-4866:2010 *Mechanical vibration and shock*.

(i) Vibration amenity

Receiver	Period of application	Vibration limit	Measurement location
Any occupied building housing an activity sensitive to noise	22:00 to 07:00	0.3 mm/s PPV	In the corner of the floor of the storey of interest for any occupied multi-storey building, or within 500 mm of ground level at the foundation of any occupied single storey building
	07:00 to 22:00	2.0 mm/s PPV	
All other occupied buildings	At all times	2.0 mm/s PPV	

Construction vibration may exceed the amenity limits in the above table where:

- The exceedances occur on a total of no more than three days per project and only between the hours of 07:00 and 18:00, Monday to Saturday

- ii. The vibration generated on these days complies with a limit of 5.0 mm/s PPV in any axis (unless a lower limit for avoiding building damage applies, in which case the lower limit must be complied with)
- iii. The occupants of all buildings where levels greater than 2.0 mm/s PPV are expected have been advised in writing no less than three days before the vibration-generating 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.

(ii) Building damage

Type of structure	Short-term vibration			Long-term vibration	
	Peak particle velocity in any axis at the building foundations when measured within 500 mm of the ground			Peak particle velocity at the topmost floor, horizontal direction, all frequencies	Peak particle velocity at the topmost floor, horizontal direction, all frequencies
	1-10 Hz	10- 50 Hz	50-100 Hz		
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20 mm/s	20-40 mm/s	40-50 mm/s	40 mm/s	10 mm/s
Residential buildings and buildings of similar design and/or occupancy	5 mm/s	5-15 mm/s	15-20 mm/s	15 mm/s	5 mm/s
Structures that are particularly sensitive to vibration and are of great intrinsic value	3 mm/s	3-8 mm/s	8-10 mm/s	8 mm/s	2.5 mm/s

Short-term vibration means vibration that does not occur often enough to cause material fatigue, and its development over time and duration is not suitable for producing a significant increase in vibration due to resonance in the structure. Long-term vibration means any other type of vibration.

The PPV limit increases linearly over the frequency range where a range of vibration velocities is specified.

Vibration must be measured and assessed in accordance with DIN 4150-3:2016 *Vibration in buildings – Part 3: Effects on structures*.

Option 4 provides the same outcome as option 2 but sets out the requirements of DIN 4150–3:2016 in the rule instead of referring to the Standard.

4.0 Construction noise standard

This section sets out our comments on the current construction noise standard, options for enabling high-noise activities that are typically associated with construction projects in built up areas, recommended construction noise limits, information regarding construction noise that should be considered with resource consent applications, and options for updated construction noise standards.

4.1 Appropriateness of the 2GP construction noise standards

The 2GP permitted construction noise limits are set out in standard 4.5.4.1. These are based on the guideline noise limits of NZS 6803:1999 *Acoustics – Construction Noise*. The numerical noise limits are determined based on the duration of the construction work at any one location per project. Activities that exceed the L_{Aeq} performance standards by less than 5 dB are discretionary activities. The activity status becomes non-complying where the L_{Aeq} performance standard is exceeded by 5 dB or more.

Table 3 displays our general descriptions of the potential effects of noise typically generated by construction works for reference when considering the appropriateness of permitted standards. The descriptions of internal noise effects are based on the windows of the receiving building being closed and a noise level reduction of approximately 20 dB being achieved through the façade. This represents a worst-case scenario because for modern dwellings and commercial buildings a reduction of 25-30 dB through the façade is more likely. These effects are typically experienced intermittently over the day due to the nature of construction works.

Table 3: General descriptions of construction noise effects

Noise level at 1 m from the façade assessed in accordance with NZS 6803:1999	Potential daytime noise effects outside the building	Potential daytime effects inside the nearest rooms of the building	Comparison with current 2GP permitted standards for projects longer than 20 weeks
55-65 dB $L_{Aeq(15\text{ min})}$	Conversation may require raised voices over long distances (e.g., 5-10 m).	Noise levels will be noticeable, but they are unlikely to disrupt noise sensitive activities.	Compliant.
65-70 dB $L_{Aeq(15\text{ min})}$	Conversation will require raised voices. People will likely seek respite from the noise by going inside.	Slightly raised sound levels may be necessary for television, radio, and phone conversations.	Compliant.

Noise level at 1 m from the façade assessed in accordance with NZS 6803:1999	Potential daytime noise effects outside the building	Potential daytime effects inside the nearest rooms of the building	Comparison with current 2GP permitted standards for projects longer than 20 weeks
70-75 dB $L_{Aeq}(15 \text{ min})$	Conversation will require raised voices. People are unlikely to spend time outside. Businesses that involve substantial outdoor use will experience considerable disruption.	Concentration may be affected but activities such as office work and working from home can generally continue. Sound levels for television, radio, and phone conversations will need to be raised.	Up to 5 dB above 2GP permitted construction noise limits.
75-80 dB $L_{Aeq}(15 \text{ min})$	Conversation will be difficult, even with raised voices. Some people may choose to wear hearing protection for long periods of exposure. Likely to disrupt most outdoor activities.	Activities such as office work and working from home will become difficult and unproductive. People are likely to seek respite from the noise by moving to another room if possible.	Up to 10 dB above 2GP permitted construction noise limits.
>80 dB $L_{Aeq}(15 \text{ min})$	Hearing protection would be required for prolonged exposure (e.g., 8 hours at 85 dB L_{Aeq}). Very intrusive and disruptive.	Untenable for office and residential environments. Unlikely to be tolerated for more than a brief exposure	More than 10 dB above 2GP permitted construction noise limits.

We consider that the numerical construction noise limits, time periods, and assessment locations included in the 2GP (adopted from NZS 6803:1999) are appropriate but could potentially be relaxed to enable typical and long-term works in built up areas within zones where high noise levels are anticipated.

Construction activities involving the use of heavy machinery in built up areas will commonly generate noise levels greater than 70 dB L_{Aeq} outside multiple-level buildings on neighbouring sites, even when adopting physical noise mitigation measures such as acoustic barriers and shrouds and using the lightest plant practicable.

In our experience, intermittent construction noise levels greater than 70 dB L_{Aeq} outside residential and commercial buildings during daytime hours can be tolerated by the occupants for short durations if they have been consulted before the works start, and the noise is no louder than necessary.

The potential effects of construction noise are determined by many factors, including:

- The noise level
- The time of day that it occurs

- Whether the noise is continuous or intermittent
- How often it occurs
- The total duration
- The existing levels of noise in the area
- The expectations at neighbouring sites
- The sensitivity of activities on the neighbouring sites to noise.

Assessment criteria that include the above factors will generally result in relevant and consistent information being provided with applications.

Standards 9.7.4.5 and 9.8.2.6 of the 2GP provide guidance on the assessment of discretionary and non-complying standard contraventions, respectively. These standards both provide general assessment guidance that include most of the factors discussed above. In our experience, the only important factor for determining construction noise effects that is not included in the 2GP assessment guidance is the expectation of the occupants in neighbouring buildings e.g., are the receivers in an area where long-term noisy construction works could reasonably be expected.

4.2 Technical information that should be considered as part of resource consent applications

The exact details of the construction methodology and plant to be used may not be available at the consenting stage. Particularly where a contractor has not been appointed. In such cases, the application should include a worst-case assessment based on a reasonable estimation of the construction programme and plant requirements. This sets an envelope of effects that the decision-maker can consider, and the consent holder will need to comply with. The alternative is to encourage early engagement with a contractor to enable a reasonable understanding of the construction process and the likely construction noise and vibration effects.

In our experience, it is problematic to grant consent to construction works based on compliance with the permitted standards where it has not been demonstrated by the applicant that this is possible by using practicable measures. Significant delays and costs can be incurred by the consent holder when it is discovered that compliance cannot be achieved.

We consider that it is also inappropriate to authorise unquantified infringements of the standards through a management plan approach with no upper limits or duration prescribed by the conditions. This can enable unreasonable disruption at the neighbouring sites that was not considered at the consenting stage.

The following sets out the nature of the technical information that should be provided with resource consent applications for activities that infringe permitted construction noise limits. In our experience, assessment criteria should require this information to be provided with applications where the permitted standards for construction noise cannot be complied with.

1. A description of the general construction methodology and noise generating equipment to be used for the works.
2. A statement that all assessments have been undertaken in accordance with NZS 6803:1999.
3. The methodology and sound power levels used to calculate the construction noise levels.
4. The details of the proposed noise mitigation measures, including:
 - i. Physical measures such as acoustic barriers and shrouds, and any restrictions on plant size and operating distances
 - ii. Management based measures such as consultation with neighbours before the works begin, restrictions on timing for high-noise activities, and implementing a Construction Noise and Vibration Management Plan (**CNVMP**).
5. The worst-case and typical construction noise levels predicted at the most exposed facades of the neighbouring sites, including all forms of proposed mitigation.
6. An assessment of the noise levels that will infringe the permitted standards, including the degree of the infringement, and the time of day it will occur, how often, and over what duration.
7. A description of the potential effects and the level of disruption that is expected from the infringements in the context of the overall project, the level, timing, frequency, duration, and character of the noise, the activities on the neighbouring sites, and the existing ambient noise levels (where relevant).

4.3 Options for construction noise standards

This section provides options for enabling long-term construction projects to occur in built-up areas while ensuring that adverse effects from construction noise can be managed. We have also provided an overview of the costs and benefits of each option in terms of potential effects.

4.3.1 Construction noise option 1

Option 1 does not include any changes to the numerical noise limits, time periods, or assessment locations as they are set out in Tables 4.5.4.1.a.i and 4.5.4.1.a.ii of the 2GP but does enable situations where the noise limits can be exceeded as a permitted activity.

Option 1 is to include the following in the existing rule:

Typical and long-term construction project activities within Port, Industrial and Commercial and Mixed Use zones may exceed the construction noise limits where:

- i. The exceedances occur on a total of no more than three days per project, and only occur between the hours of 07:30 and 18:00, Monday to Saturday.
- ii. The exceedances generated at these times consistently comply with a limit of 80 dB $L_{Aeq}(15 \text{ min})$.

- iii. The occupants of all buildings where exceedances of the noise limits are expected have been advised in writing no less than three days before the works begin. The written advice must include details of the location and duration of the works, and a contact name and phone number for questions and complaints.

From a noise effects perspective, the criteria above would ideally also include a Construction Noise and Vibration Management Plan (CNVMP) that is prepared by a suitably qualified and experienced person and submitted to Council before the works begin. We acknowledge the difficulties in requiring the preparation of a management plan in permitted rules. We have set out below the merits of including this requirement in terms of managing the noise effects of a construction project where the guideline limits of NZS 6803:1999 will be exceeded. But the disadvantages in terms of planning best practice and council's internal processes will need to be considered by others.

The provision of a CNVMP for the project would help to ensure that noise emissions are minimised wherever practicable, and that noise will only exceed the limits in Tables 4.5.4.1.a.i and 4.5.4.1.a.ii for up to three days if this is necessary to complete the works e.g., to drive piles or break out foundations near to a neighbouring occupied building. In our experience, a CNVMP is an important tool for mitigating construction noise effects, and it is referenced by NZS 6803:1999 as being appropriate for achieving the aims of the Standard. An example of where this approach has been used in other District Plans is AUP standard E25.6.29 for construction works in the road.

The aim of the CNVMP and the minimum requirements should be made clear in the rule itself. We suggest that the criteria of standard E25.6.29.5 of the AUP are used as the basis for developing the rule if the provision of a CNVMP is to be included. These are provided in Appendix B.

Option 1 (with or without the provision of a CNVMP) enables construction noise levels that are generally expected for short periods during medium to large scale projects within built up areas. High levels of noise are anticipated in Port, Industrial and Commercial and Mixed Use zones and we do not expect the additional noise over a short period would unreasonably disrupt office work, commercial activities, or noise sensitive activities if consultation is undertaken. Consultation with the occupants of nearby buildings is discussed as being an important mitigation tool in NZS 6803:1999.

The suggested period of three days for higher noise limits is based on our experience in the assessment of construction noise. Noise levels higher than the guideline limits of NZS 6803:1999 can be tolerated for short periods where there is prior consultation. However, people become less tolerant when this period is greater than approximately three days. The period for higher noise levels stated in a rule based on Option 1 could be longer than three days but this will result in greater effects. The likelihood that such effects will be tolerated by the occupants of the receiving buildings will depend on the factors that we have recommended as assessment criteria for construction noise in Section 4.1.

A three-day period is often sufficient for small to medium construction projects to complete high noise works near to occupied buildings. Noise generated outside of the three-day period must comply with the typical or long-term standards. There are typically mitigation options available to achieve this, such as using smaller plant. In our experience, construction projects that will generate high noise levels for more than three days will typically also require consent in other areas.

Consent will be required if construction noise levels will exceed the limits in Tables 4.5.4.1.a.i or 4.5.4.1.a.ii on more than three days or outside the hours of 07:30 to 18:00, Monday to Saturday, or where the noise will exceed 80 dB $L_{Aeq}(15 \text{ min})$ at any time.

We recommend that assessment criteria are included for applications that infringe the permitted construction noise limits in Option 1. We have provided the AUP assessment criteria for restricted discretionary activities in Appendix B of this document for reference. These are similar to standards 9.7.4.5 and 9.8.2.6 of the 2GP.

4.3.2 Construction noise option 2

Option 2 is to update Rule 4.5.4.1 to enable noise limits of up to 75 dB during the day for long-term projects within zones where high levels of noise are anticipated, as follows:

4.5.4.1 Construction

- a. Construction noise must not exceed the following limits outside any building that is occupied during the works, and must be measured and assessed in accordance with NZS 6803:1999 *Acoustics – Construction Noise*
 - i. **Construction noise received at any building housing a noise sensitive activity in any zone except the Industrial, Port, and Commercial and Mixed Use zones but including Centres, Smith Street, and York Place**

Time of week	Time period	Duration of work					
		1. Typical duration (dBA)		2. Short-term duration (dBA)		3. Long-term duration (dBA)	
		L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax}
Weekdays	6.30am - 7.30am	60	75	65	75	55	75
	7.30am - 6.00pm	75	90	80	95	70	85
	6.00pm - 8.00pm	70	85	75	90	65	80
	8.00pm - 6.30am	45	75	45	75	45	75

Time of week	Time period	Duration of work					
		1. Typical duration (dBA)		2. Short-term duration (dBA)		3. Long-term duration (dBA)	
		L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}
Saturdays	7.30am - 6.00pm	75	90	80	95	70	85
	6.00pm - 7.30am	45	75	45	75	45	75
Sundays and Public Holidays	7.30am - 6.00pm	55	85	55	85	55	85
	6.00pm - 7.30am	45	75	45	75	45	75

- ii. **Construction noise received in Industrial and Port zones except at any building housing a noise sensitive activity**

Time period	Duration of work	
	1. Typical and Long-term duration	2. Short-term duration
	L _{Aeq} (dBA)	L _{Aeq} (dBA)
7.30am - 6.00pm on all days	75	80
6.00pm - 7.30am on all days	80	85

- iii. **Construction noise received at any building housing a noise sensitive activity within Industrial and Port zones, and at any building within the Commercial and Mixed Use zones except for Centres, Smith Street and York Place**

Time period	Duration of work	
	1. Typical & Long-term duration	2. Short-term duration
	L _{Aeq} (dBA)	L _{Aeq} (dBA)
7.00am - 10.00pm on all days	75	80
10.00pm - 7.00am on all days	60	60

Option 2 enables noise levels that are generally expected during medium to large scale construction projects in built up areas. The permitted standard for long-term projects is 5 dB higher within Industrial, Port, and Commercial and Mixed Use zones (excluding Centres, Smith Street, and York Place) when compared with the existing 2GP rule.

The noise levels enabled would not be expected to unreasonably disrupt office work, commercial activities, or noise sensitive activities in the respective zones. The highest noise limits within Industrial, Port, and Commercial and Mixed Use zones are 5 dB lower during the day than for Option 1, but there is no restriction on the duration of the highest noise levels. The level of effect between Options 1 and 2 are therefore similar our opinion.

Option 2 is a similar approach to that of the AUP, which specifies higher permitted construction noise limits for zones in the Business – City Centre Zone and Business – Metropolitan Centre Zone for long-term projects.

We recommend that assessment criteria are included for applications that infringe the permitted construction noise limits in Option 2.

4.3.3 Construction noise option 3

Option 3 is the same as Option 2 except for the following addition as 4.5.4.1.a.iv:

- iv. **Typical and long-term construction project activities within Port, Industrial, and Commercial and Mixed Use zones may exceed the construction noise limits in (ii) and (iii) above where:**
 - i. The exceedances occur on no more than three days per project, and only occur between the hours of 07:30 and 18:00, Monday to Saturday
 - ii. The exceedances generated at these times consistently comply with a limit of 80 dB $L_{Aeq}(15 \text{ min})$
 - iii. The occupants of all buildings where exceedances of the noise limits are expected have been advised in writing no less than three days before the works begin. The written advice must include details of the location and duration of the works, and a contact name and phone number for questions and complaints.

The criteria above would ideally also include the provision of a CNVMP as discussed for Option 1.

Option 3 incorporates elements of Options 1 and 2. It enables higher construction noise levels than the 2GP during the day in Industrial, Port, and Commercial and Mixed Use zones (excluding Centres, Smith Street, and York Place), but also enables a three-day period of noise levels up to 80 dB L_{Aeq} .

The three-day period of construction noise up to 80 dB L_{Aeq} may have a greater effect on receivers than under Option 1. Under Option 3 the noise on all other days may be up to 75 dB L_{Aeq} so the respite from the period highest noise is not as great (when compared to Option 1 where the noise will be no greater than 70 dB L_{Aeq} at all other times). For reference,

a noise level that increases by 10 dB will be subjectively twice as loud. An increase of 5 dB will be perceived as 50% louder.

The noise levels enabled under Option 3 would not be expected to unreasonably disrupt office work, commercial activities, or noise sensitive activities in the respective zones. However, the noise levels and effects over the duration of the project would be noticeably greater when compared to Options 1 and 2.

We recommend that assessment criteria are included for applications that infringe the permitted construction noise limits in Option 3.

5.0 Summary

Styles Group has provided expert evidence to inform potential changes to the 2GP permitted construction noise and vibration standards in accordance with the brief provided by DCC.

We have reviewed the construction vibration limits of the 2GP and consider they are not appropriate for avoiding potential cosmetic building damage, or for controlling potential effects on the amenity of the building occupants. There is no activity status or assessment guidance provided by the 2GP for infringements of these standards.

We have described the potential effects of construction vibration typically considered with resource consent applications and have recommended options for updated permitted construction vibration limits to avoid building damage and manage effects on the occupants of buildings.

We have reviewed the construction noise limits of the 2GP and consider that the numerical limits, time periods, and assessment locations currently included in the 2GP are generally appropriate but could be relaxed to enable works during typical and long-term projects within zones where higher noise levels are anticipated.

We have set out minimum requirements for technical information that should be considered as part of resource consent applications where it is proposed to infringe the permitted standards.

We have described the potential effects of construction noise typically considered with resource consent applications. We have recommended options for updated permitted construction noise limits. These enable higher noise levels typically expected in built up areas while ensuring that potential adverse effects from construction noise are appropriately managed to varying degrees.

We have described the factors that should be considered when determining the level of construction noise effects. Standards 9.7.4.5 and 9.8.2.6 of the 2GP provide general assessment guidance that includes most of the factors we have described. We have provided a further example of assessment criteria from the AUP. In our experience, providing assessment criteria for activities that do not comply with the permitted standards will generally result in relevant and consistent information and assessments being provided with applications.

In accordance with our brief, we have not made recommendations on the preferred options for updated construction noise and vibration standards.

Appendix A Glossary of terms

Noise	Noise is unwanted, harmful, or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid, or solid. Noise usually includes vibration as well as sound. The Resource Management Act defines noise as “includes vibration”.
Decibel (dB)	The decibel is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy. When used in acoustics it relates to one of the following: • The ratio of the square of the sound pressure level to a reference sound pressure level • The ratio of the sound power level to a reference sound power level • The ratio of the sound intensity level to a reference sound intensity level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines will increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one, so the logarithmic decibel scale is useful for acoustical assessments.
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound i.e., 500 Hz to 6 kHz. Humans are most sensitive to midrange frequency sounds, such as a child’s scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximate the human loudness response at low sound levels. It should be noted that the human loudness response is different from the human annoyance response to sound. Low frequency sounds can be more annoying than midrange frequency sounds even at low levels. A-weighting is the most used frequency weighting for environmental noise assessments.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it considers the total sound energy over the time period of interest. Human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than other noise level descriptors.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
NZS 6803:1999	N.Z. Standard NZS 6803:1999 <i>Acoustics – Construction noise</i> .

DIN 4150–3:2016	German Standard DIN 4150-3:2016 <i>Vibrations in buildings – Part 3: Effects on structures</i> . Typically adopted for the assessment of structure borne vibration in New Zealand.
Peak particle velocity (PPV)	The standard metric for ground borne vibration in New Zealand, measured in mm/s. The instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
CNVMP	Construction noise and vibration management plan. A document to help the contractor manage noise and vibration emissions during construction works.

Appendix B Other District Plan references

Auckland Unitary Plan

Construction vibration

E25.6.30. Vibration

- (1) Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed:
- (a) the limits set out in German Industrial Standard DIN 4150-3 (1999):
Structural vibration – Part 3 Effects of vibration on structures when measured in accordance with that Standard on any structure not on the same site; and
 - (b) the limits in Table E25.6.30.1 Vibration limits in buildings in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

Table E25.6.30.1 Vibration limits in buildings

Receiver	Period	Peak Particle Velocity Limit millimetres/second
Occupied activity sensitive to noise	Night-time 10pm to 7am	0.3 mm/s
	Daytime 7am to 10pm	2 mm/s
Other occupied buildings	At all times	2 mm/s

Works generating vibration for three days or less between the hours of 7am to 6pm may exceed the limits in Table E25.6.30.1 Vibration limits in buildings above, but must comply with a limit of 5mm/s peak particle velocity in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building, where:

- (i) all occupied buildings within 50m of the extent of the works generating vibration are advised in writing no less than three days prior to the vibration-generating works commencing; and
- (ii) the written advice must include details of the location of the works, the duration of the works, a phone number for complaints and the name of the site manager.

Construction noise

Construction noise

E25.6.27. Construction noise levels in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone

- (1) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured 1m from the façade of any building that contains an activity sensitive to noise that is occupied during the works.

Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Time of week	Time Period	Maximum noise level (dBA)	
		L _{eq}	L _{max}
Weekdays	6:30am - 7:30am	60	75
	7:30am - 6:00pm	75	90
	6:00am - 8:00pm	70	85
	8:00pm - 6:30am	45	75
Saturdays	6:30am - 7:30am	45	75
	7:30am - 6:00pm	75	90
	6:00am - 8:00pm	45	75
	8:00pm - 6:30am	45	75
Sundays and public holidays	6:30am - 7:30am	45	75
	7:30am - 6:00pm	55	85
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75

- (2) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.2 Construction noise levels for noise affecting any other activity when measured 1m from the façade of any other building that is occupied during the works.

Table E25.6.27.2 Construction noise levels for noise affecting any other activity

Time Period	Maximum noise levels Leq dBA
7:30am – 6:00pm	75
6:00pm – 7:30am	80

- (3) For a project involving a total duration of construction work that is less than 15 calendar days, the noise levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be increased by 5dB in all cases.
- (4) For a project involving a total duration of construction work that is more than 20 weeks the noise limits in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be decreased by 5dB in all cases.

E25.6.28. Construction noise levels in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

- (1) Construction activities in the Business – City Centre Zone and the Business – Metropolitan Centre Zone must comply with Standard E25.6.27(1) above for any receiver not in a Business – City Centre Zone or a Business – Metropolitan Centre Zone and must not exceed the levels in Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured for any 30 minute period 1m from the façade of any building in the Business – City Centre Zone or the Business – Metropolitan Centre Zone that is occupied during the work.

Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Construction of less than 15 consecutive calendar days duration (total duration of works)		
Time	L _{Aeq} (30 min)	L _{AFmax}
Monday to Friday 6.30am - 10.30pm	80 dB	90 dB
Saturday 7am - 11pm	85 dB	90 dB
Sunday 9am - 7pm	80 dB	90 dB
All other times (night time)	60 dB	75 dB
All other times in the City Centre Residential Precinct and the Learning Precinct	55 dB	75 dB

Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Construction of 15 consecutive calendar days or more (total duration of works)		
Time	L _{Aeq} (30 min)	L _{AFmax}
Monday to Friday 6.30am-10.30pm	75 dB	90 dB
Saturday 7am-11pm	80 dB	90 dB
Sunday 9am-7pm	65 dB	85 dB
All other times (night time)	60 dB	75 dB
All other times in the City Centre Residential Precinct and the Learning Precinct	55 dB	75dB

Where external measurement of construction noise is impractical or inappropriate, the upper limits for the noise measured inside the building will be 20dB less than the relevant levels in Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone above.

CNVMP criteria for a permitted activity

E25.6.29. Construction noise levels for work within the road

- (5) A construction noise and vibration management plan must be prepared by a suitably qualified and experienced person and include the following:
- (a) details of the community consultation to be undertaken to advise the occupiers of properties located within 100m of the proposed works of all of the following:
 - (i) the area affected by the work;
 - (ii) why the work is required to be undertaken at night (where relevant);
 - (iii) the times and days when the noise and vibration is likely to be generated;
 - (iv) a contact name and number of the works supervisor who can be contacted if any issues arise; and
 - (v) how noise and vibration complaints will be managed and responded to;
 - (b) a description of the works and its duration, anticipated equipment to be used and the processes to be undertaken; and
 - (c) identification of the best practicable options that will be undertaken to mitigate and minimise any noise being produced that is likely to exceed the relevant levels of the following tables:
 - (i) Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or
 - (ii) Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or
 - (iii) Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or
 - (iv) Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone.

Assessment criteria

E25.8.2. Assessment criteria

The Council will consider the relevant assessment criteria for restricted discretionary activities from the list below:

(1) for noise and vibration:

- (a) whether activities can be managed so that they do not generate unreasonable noise and vibration levels on adjacent land uses particularly activities sensitive to noise;
- (b) the extent to which the noise or vibration generated by the activity:
 - (i) will occur at times when disturbance to sleep can be avoided or minimised; and
 - (ii) will be compatible with activities occurring or allowed to occur in the surrounding area; and
 - (iii) will be limited in duration, or frequency or by hours of operation; and
 - (iv) will exceed the existing background noise and vibration levels in that environment and the reasonableness of the cumulative levels; and
 - (v) can be carried out during daylight hours, such as road works and works on public footpaths.
- (c) the extent to which the effects on amenity generated by vibration from construction activity:
 - (i) will be mitigated by written advice of the activity to adjacent land uses prior to the activity commencing; and
 - (ii) can be mitigated by monitoring of structures to determine risk of damage to reduce occupant concern; and
 - (iii) can be shown to have been minimised by the appropriate assessment of alternative options; and
 - (iv) are reasonable taking into account the level of vibration and the duration of the activity (where levels of 10mm/s peak particle velocity may be tolerated only for very brief periods).
- (d) whether the measures to minimise the noise or vibration generated by the activity represent the best practicable option.

Queenstown Lakes District Council Proposed District Plan

Construction vibration

Rule Number	Specific Standards				Non-compliance Status
	Activity or sound source	Assessment location	Time	Noise Limits	
36.5.9	Vibration Vibration from any activity shall not exceed the guideline values given in DIN 4150-3:1999 Effects of vibration on structures at any buildings on any other site.	On any structures or buildings on any other site.	Refer to relevant standard	Refer relevant standard to NC	