



Eagle Quarter, Newbury

Construction Noise and Vibration Assessment

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prepared for

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1.0 Introduction

1.1 The existing Kennet Centre in Newbury is to be redeveloped and is expected to consist of mixed used residential and retail with the existing Vue cinema to be retained.

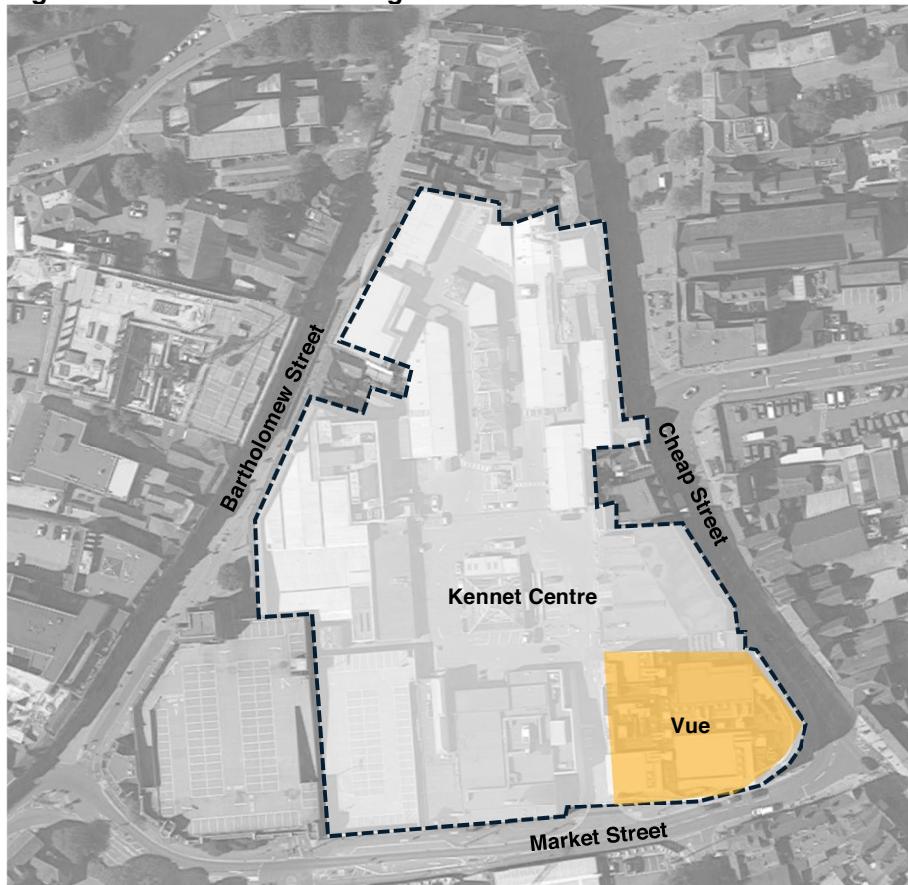
1.2 The Vue cinema will be sensitive to noise and vibration ingress during demolition and construction phases. This report details the conclusions to the assessment of demolition / construction noise to this receptor.

1.3 This report is written for the benefit of the contractor and the client for the development and is not intended to be submitted as part of any planning application.

2.0 Locality

2.1 The Kennet Centre is located centrally within Newbury, as shown in **Figure 1** below. The site is bound by Market Street, Bartholomew Street and Cheap Street to the south, west and east respectively.

Figure 1: Site and surrounding area



2.2 The Vue cinema is located at the south-east corner of the site, which is to be retained. The remainder of the development is to be demolished with redevelopment expected to contain residential and commercial spaces.

3.0 Criteria

3.1 The Vue requirements for noise within cinema spaces from sources of temporary nature (e.g. construction activity) are presented within the table below, in terms of average noise levels within a 15-minute period, $L_{Aeq,15min}$ and maximum noise levels, $L_{Amax,F}$:

Table 1 Construction noise limits within cinema spaces

Cinema Space	Construction Noise Limits, dB	
	$L_{Aeq,15min}$	$L_{Amax,F}$
Auditoria	30	50
Other occupied spaces	40	60

3.2 With regards to vibration, the requirement is to not exceed Curve 1, presented within the superseded BS 6272:1992. Specifically, vibration levels within any auditoria should not exceed a peak velocity of 0.14 mm/s at frequency 8 Hz to 80 Hz, increasing up to 2.2 mm/s at 1 Hz.

3.3 Additionally, any vibration which has an impact on the projected image would be unacceptable, particularly for 3D films. This would be due to excitation of the building structure itself, therefore a cautious approach should be taken with when heavy operations are taking place alongside demolition activity which impact the existing building structure itself.

3.4 The amount of risk that a demolition / construction activity will have on the operation of the cinema auditoria is defined within the table below.

Table 2 Traffic light system for the risk of operations within auditoria from construction activity

Risk Factor	Effect
Red	Highly expected that the Vue requirements will be exceeded
Amber	Potential for Vue requirements to be exceeded
Green	Not expected for Vue requirements to be exceeded

3.5 It is noted that noise and vibration from construction that falls within the “green” category may still be notable within the auditoria and cinema goers’ experience may still be adversely affected to some degree. The Vue requirements represents a pragmatic approach between allowing the necessary construction works to take place and reducing the potential for complaints / adverse comments with the traffic light system presenting the likelihood that these requirements will be exceeded.

4.0 Vue Sound Isolation

4.1 Measurements were undertaken across a sample of auditoria to determine the fire escape doorset performances (when not lobbied), by measuring noise simultaneously within the auditoria centrally within the raised seating and 1 m from the door externally with loud action movie trailers playing (specifically *Ant-Man and the Wasp: Quantumania*, *Fast X*, *Creed III* and *Guardians of the Galaxy Vol. 3*).

4.2 The difference in measured noise levels have been used to determine the apparent sound reduction index of the existing doorsets, as presented in **Table 3**. The external levels were background corrected to remove any contributions from the ambient noise climate in absence of cinema break-out noise. Audio recordings from both monitors were used to verify the noise levels measured were from the same activity (i.e. the movie trailer rather than a separate noise source).

4.3 The performance of the façade in absence of the fire escape doorsets was not possible to measure due to the external noise levels not being audible (or measurable) above the ambient noise levels. Instead, the predicted performance of the existing façade construction (based on manufacturer's performance data) is presented in the table, with the descriptor for the construction detailed also.

Table 3 Sound insulation of external elements

Separation	Performance	Construction
On-site doorsets	R'_w 32 dB	Originally specified to be acoustic rated metal core doorsets
Façade	R'_w 65 dB	External cladding / rain screen Cavity with insulation Pyroc board Cavity with insulation 2 x 15 mm plasterboard Cavity with 100 mm glass fibre quilt Independent lining of 2 x 15 mm GTEC Sound Board

4.4 Auditoria which currently have fire escapes which are non-lobbied are 5, 6 and 7 and will therefore be the most sensitive to noise from demolition / construction activity.

5.0 Assessment

5.1 Noise Sources

5.1.1 A proposed schedule of demolition and construction activity and the relative phasing has been provided by the contractors, *Blue Sky Building*. Specific equipment has been assumed for each activity group within each of the phases, as presented in **Appendix A**.

5.1.2 The specific noise levels adopted for each activity and the reference location for the respective levels are presented in the attached **Appendix B**.

5.1.3 Each activity group as well as each piece of equipment individually has been assessed into the Vue auditoria during a 15-minute daytime period. It has been assumed that all equipment will operate for 90% of the time during the period as a worst-case except the on-site vehicles, which are assumed to operate for 10% of the period.

5.2 Structure-borne Noise and Vibration

5.2.1 Prior to the works that are to be undertaken to separate the Vue cinema from the rest of the structure, there is risk of structure-borne noise and vibration transfer from activities which excite the building's construction. The auditoria isolation will assist with mitigating some of the noise and vibration transferring via the structure, particularly at around 30 Hz and above. Heavily percussive activities which vibrates the structure at lower frequencies will potentially elevate noise and vibration levels within any auditorium, particularly when the excited structure is located near to the cinema area.

5.2.2 This is expected to relate particularly to the 'Soft strip' and 'Vue cinema separation works' phases. The typical frequency content for each piece of equipment expected to be used during these phases have been reviewed in combination with whether the respective equipment is expected to be heavily percussive to excite the building structure.

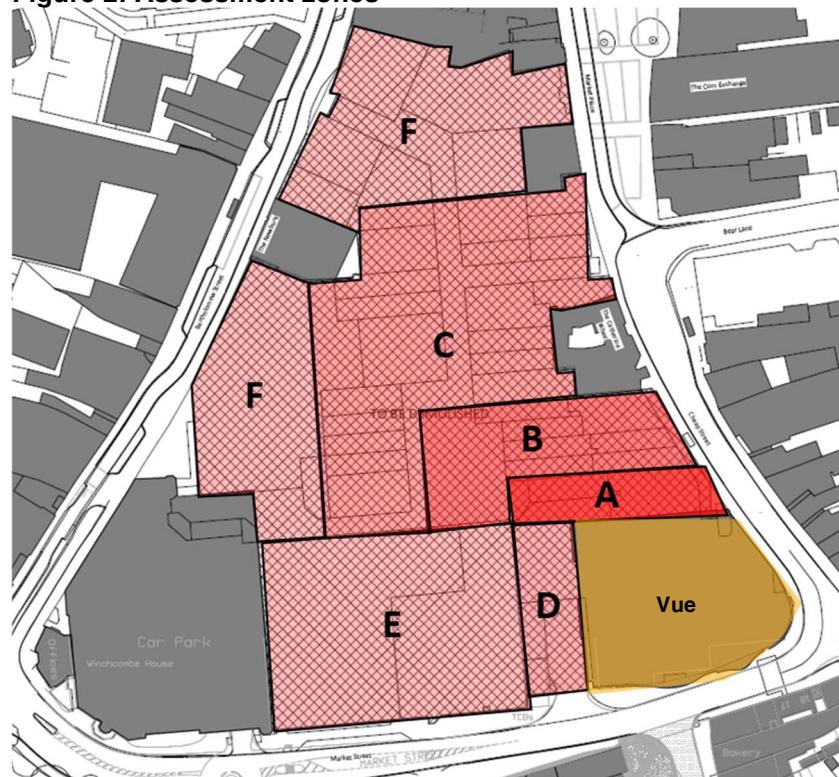
5.2.3 Structure-borne noise could affect all of the auditoria, including screens not located along the perimeter of the building. Noise and vibration levels have been reviewed and level of risk determined for these phases, as presented in **section 5.4**.

5.2.4 It has been assumed that all later phases will not be undertaken until the Vue cinema separation works are complete.

5.3 Assessment Zones

5.3.1 Noise and vibration have been assessed for each activity group from six different assessment zones, as shown on the figure below and labelled A to F.

Figure 2: Assessment zones



5.4 Risk Effects from Demolition / Construction Phases

Soft Strip

Week 3 to 17

5.4.1 The soft strip of the site is expected to involve the removal of all non-structural elements. There is potential that the use of equipment such as angle grinders or other motorised cutting equipment may excite the structure, resulting in transmittal of structure-borne noise into the auditoria.

5.4.2 The following level of risk has therefore been assigned during this phase.

Table 4 Level of risk assigned within each auditorium during soft strip at each assessment zone

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Soft strip & removal	All							

5.4.3 Specifically, the equipment which has determined the above risk are the lower frequency percussive type, which in this instance are expected to include the oxy propane cutting kit and the excavators. Angle grinders on steel and hand tools are expected to not be as significant and would likely not impact the use of the auditoria.

Vue Cinema Separation Works – Demolish Existing Escape Stair

Week 5 to 28

5.4.4 Escape stairs are currently located along the western façade near Auditorium 2, 3 and 4 and the northern façade near Auditorium 5.

5.4.5 The following level of risk has been determined during this activity group.

Table 5 Level of risk assigned within each auditorium during demolition of existing escape stair as part of the Vue cinema separation works phase (with existing doorsets to auditoria 5, 6 and 7)

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Demolish existing escape stair	A							
	D							

5.4.6 It is only expected for a high level of risk of the Vue noise limits being exceeded occurring when the works take place in close proximity to auditoria with the existing non-lobbied doorsets (i.e. Auditorium 5).

Vue Cinema Separation Works – Structural Separation

Week 5 to 28

5.4.7 The structural separation works is a key phase with there being a likelihood that structure-borne noise will transmit into all of the cinema auditoria due to the structure being excited by motorised cutting equipment in particular.

5.4.8 The following level of risk has therefore been assigned during this phase.

Table 6 Level of risk assigned within each auditorium due to structural separation of Vue as part of the Vue cinema separation works phase

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Structural separation	A							
	D							

5.4.9 Structural separation works are proposed to be undertaken during a 24-week period. It may therefore prove beneficial to undertake a trial run of the expected activities at the start of the period (or even prior to this if possible, during a period when the cinema is not in use), monitoring within the auditoria to determine whether structure-borne noise is indeed an issue. If it proves the noise limits are not exceeded within any of the auditoria, then the respective auditorium could then be made available for use (providing this allows enough notice for this option to be commercially viable).

Vue Cinema Separation Works – Demolish Locally & Structural Superstructure Locally

Week 5 to 28

5.4.10 Once the structure has been separated, the remaining local structure around the Vue cinema will be demolished. With the structure separated from the Vue cinema, it is expected for structure-borne noise to not be as significant so that noise will predominantly be via airborne paths only (i.e. through the façade and external doors).

5.4.11 The following level of risk has therefore been assigned during this phase.

Table 7 Level of risk assigned within each auditorium due to local demolition to Vue cinema

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Demolish locally	A							
	D							
Structural superstructure locally	A							
	D							

5.4.12 Due to works occurring in close proximity to the auditoria, it is highly likely the Vue requirements will be exceeded within auditoria 5 to 7 due to noise transferring via the external doorsets.

Hard Demolition Zones

Week 7 to 32

5.4.13 This phase covers demolition across the site as a whole and so noise has been calculated from all of the assessment zones into the auditoria.

5.4.14 The following level of risk has therefore been assigned during this phase.

Table 8 Level of risk assigned within each auditorium due to demolition across the site

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Demolition sitewide	A							
	B							
	C							
	D							
	E							
	F							

Substructures – Piling Mat

Week 41 to 74

5.4.15 It is understood that piling mat activities involve diggers and dumpers preparing the site ready for piling activity. The following level of risk has therefore been assigned during this phase.

Table 9 Level of risk assigned within each auditorium due to preparation of the pile mat

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Cut / fill pile mat	A							
	B							
	C							
	D							
	E							
	F							

Substructures – Piling

Week 41 to 74

5.4.16 High levels of vibration can be experienced from activities which excite the ground and then transfer to the surrounding structures.

5.4.17 Vibration levels from CFA piling activity have been assessed as per vibration data presented in BS 5228-2. It is calculated that vibration levels will exceed the criterion when located within 50 m of the auditoria. However, the auditoria themselves may benefit from isolation being located within the construction build-up, potentially mitigating the effects from piling. Therefore, vibration from piling has been assigned as *medium* risk when beyond the directly adjacent zones (A & D) for all auditoria and that continual monitoring should take place whilst this activity is taking place.

Table 10 Level of risk assigned within each auditorium due to piling activity

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Piling	A							
	B							
	C							
	D							
	E							
	F							

5.4.18 If a more percussive piling technique was instead adopted, then it may be necessary to increase the level of risk across the site to *high*.

Substructures – Pile Caps

Week 41 to 74

5.4.19 Once piling is complete the pile caps will be constructed. This involves a number of noisy pieces of equipment and therefore the following level of risk has been assigned during this phase.

Table 11 Level of risk assigned within each auditorium due to construction of pile caps

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Pile caps	A							
	B							
	C							
	D							
	E							
	F							

Superstructure

Week 50 to 95

5.4.20 The following level of risk has been assigned during construction of the superstructure.

Table 12 Level of risk assigned within each auditorium due to construction of the superstructure

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Structural frame	A							
	B							
	C							
	D							
	E							
	F							

Envelope

Week 64 to 132

5.4.21 The following level of risk has been assigned during construction of the building envelope.

Table 13 Level of risk assigned within each auditorium due to construction of the building envelope

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
Brickwork / windows / balconies	A							
	B							

Activity Group	Zone	Level of Risk at Auditorium #						
		1	2	3	4	5	6	7
	C							
	D							
	E							
	F							

6.0 Mitigation

6.1 Hours of Construction Activity

6.1.1 To limit the periods when noise levels exceed limits in auditoria, and Vue might therefore need to avoid use of the auditoria, careful consideration could be given to the hours that construction activity is taking place. For example, noisy activities could be limited to periods when the auditoria are already expected to not be in use, or otherwise half the day could be devoted to noisier activities and the other to the less intrusive activities, were that possible to do, so that the auditoria could then be used for the half day period.

6.1.2 The majority of activities incurring a red rating and considered high risk are with respect to auditoria 5 to 7. If it was possible to limit works in assessment Zone A in particular (but also Zone B and C where manageable) to periods when these auditoria are already not expected to be used then the overall periods requiring auditoria closures would be significantly reduced.

6.2 Improved Cinema Doorsets

6.2.1 Disruption could also be reduced by upgrading the external doorsets to auditoria 5 to 7. By improving the doorsets to achieve an R'_{w} 45 dB standard, either by replacing the doorset (e.g. with IAC's Noise-Lock steel acoustic door) or improving the existing performance by inspecting all seals and construction to each of the doorsets, it is calculated that a greater number of activities can take place while the auditoria are operating.

6.2.2 Specifically, with the improved doorsets, only the following activities located at the respective assessment zone are rated as high risk for auditoria 5 to 7:

Table 14 Activity groups within respective zones rated as high risk with improved doorsets to auditoria 5 to 7

Phase	Activity Group	Zone(s)	Notes
Vue cinema separation works	Demolish existing escape stair	A	Auditorium 5 only
	Structural separation	A & D	Due to structure-borne noise
	Demolish locally	A	
	Structural superstructure	A	
Hard demolition zones	Demolition	A	
Substructures	Piling	A & D	Due to vibration
	Pile caps	A	
Superstructures	Structural frame	A	
Envelope	Brickwork / windows	A	

6.2.3 By improving the doorsets, it is assessed that only activity in Zone A for some of the phases will have a high risk of impacting cinema auditoria, with exception to structural separation works and piling which are high risk due to structure-borne noise and by vibration respectively.

6.3 Noise and Vibration Monitoring

6.3.1 For activities which are deemed *medium* or *high* risk, it is recommended that monitoring takes place within sample auditoria to measure the impact from demolition or construction activity.

6.3.2 As it is likely not possible to determine any noise impact whilst auditoria are in use, even if construction activities are audible whilst a film is playing, there are two approaches which can be adopted:

- Measure noise within an auditorium not in use but which can be considered representative of the occupied auditorium;
- Measure the activities during a period when the auditorium is not in use (e.g. the morning prior to the first showing), noting that the activity needs to be worst case for what is expected during that day, where possible.

6.3.3 Vibration monitoring can occur within the respective projection room for the auditorium.

6.3.4 The monitoring can then be used to determine whether any exceedances in the noise and/or vibration criteria are likely.

7.0 Summary

7.1 In summary, structure-borne noise should be carefully considered as all of the auditoria could be affected by any activity which excites the overall structure, particularly when heavily percussive at low frequencies. Similar consideration will also be required for piling, which may cause unsuitable levels of vibration within the auditoria.

7.2 For airborne noise, with the doorsets as they are, these auditoria (6, 7 and 8) are recommended to not be in use during operation for a number of the activities throughout the demolition and construction phases, particularly when located in close proximity to the auditoria. Conversely, any activity located 100 m or beyond from the Vue cinema boundary, is not expected to incur any risk to the noise and vibration criteria being exceeded.

7.3 By improving the doorsets to achieve an R_w 45 dB standard, either by replacing the doorset (e.g. with IAC's Noise-Lock steel acoustic door) or improving the existing performance by inspecting all seals and construction to each of the doorsets, it is calculated that a greater number of activities can take place while the auditoria are operating.

7.4 The façade in absence of doorsets is expected to control noise from the majority of activities with monitoring only recommended for some of the activity groups.



Appendix A: Site Activity

Summary description of demolition and construction activity

Demolition activity

Phase	Activity Group	Equipment
Soft strip	Soft strip & removal	Hand tools (mattocks, sledge hammers etc.)
		Mobile Elevating Work Platforms (MEWP)
		Angle grinders
		Oxy propane cutting equipment
		Excavator with selector grab
Vue cinema separation works	Demolish existing escape stair	Hand tools (mattocks, sledge hammers etc.)
		MEWP
		Angle grinders
		Oxy propane cutting equipment
	Structural separation	Hand tools (mattocks, sledge hammers etc.)
		Angle grinders
		Oxy propane cutting equipment
	Demolish locally	Demolition Rig (D-Rig) (pulveriser attachment)
		D-Rig (breaker attachment)
	Structural superstructure locally	D-Rig (pulveriser attachment)
		D-Rig (breaker attachment)
Hard demolition zones	Demolition sitewide	D-Rig (pulveriser attachment)
		D-Rig (breaker attachment)

Construction activity

Phase	Activity Group	Equipment
Substructures	Cut / fill pile mat	Digger
	Piling mat	Digger
		Dumper
	Piling	CFA piling
	Pile caps	Hydraulic cropper
		Peckers
		Angle grinders
		Compressor
		Pneumatic hammer
Superstructure	Structural frame	Concrete pumps (mobile)
		Concrete pumps (static)
		Angle grinders (steel)
		Compressor
		Scabblers

Phase	Activity Group	Equipment
		Percussion drill
		Angle grinders (concrete)
		Vibration poker
Envelope	Brickwork / windows / balconies	Masonry bench saw
Vehicles (throughout)	On-site vehicles	Muckaway truck
		Concrete vehicle
		Skips
		Mobile / crawler crane



Appendix B: Activity Noise Levels

Assumed Demolition and Construction Activity Noise Levels

Equipment	Reference ¹	Sound Pressure Level (dB) at 10 m Octave Band Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Hand tools	C.1 19	66	66	68	68	63	57	55	51
MEWP	C.4 57	78	76	62	63	60	59	58	49
MEWP (idling)	C.4 58	72	71	59	59	56	56	52	45
Angle grinders (steel)	C.4 93	57	51	52	60	70	77	73	73
Oxy propane cutting	C.1 18	72	72	69	72	73	72	71	71
Excavator selector grab	C.1 12,13	80	81	82	82	81	78	74	70
Angle grinders (concrete)	C.4 71,72	80	75	76	73	72	74	80	75
D-Rig (pulveriser)	C.1 3,4,5	79	74	72	74	72	71	68	61
D-Rig (breaker)	C.1 9	88	88	86	89	83	83	80	76
Digger	C.4 66	72	63	67	67	63	62	56	50
Dumper	C.4 5,8	72	62	53	53	58	54	47	40
CFA piling	C.3 21 22	80	80	78	77	75	72	67	61
Hydraulic cropper	Database	84	76	75	73	74	72	67	62
Peckers	Database	73	71	71	70	72	75	78	72
Compressor	Database	-	-	67	72	60	-	-	-
Pneumatic hammer	Database	84	77	74	65	68	71	73	75
Concrete pumps (mobile)	C.4 29,30	79	77	74	76	75	74	67	63
Concrete pumps (static)	C.3 25,26	83	80	71	71	72	72	65	57
Scabblers	D.6 45	87	85	85	78	74	77	75	70
Percussion drill	C.1 6	83	83	81	74	73	76	78	77
Vibrating poker	C.4 33,34	76	77	77	70	67	69	67	62
Masonry bench saw	C.4 71	85	74	72	70	72	76	82	77
Muckaway truck	Database	73	64	55	55	60	56	51	43
Concrete vehicle	C.4 20	83	74	66	69	70	78	60	55
Skips	C.8 21	82	84	78	75	71	70	65	59
Mobile / crawler crane	C.4 39	83	79	75	73	70	66	58	51



¹ Reference presented as either BS 5228-1 table reference or as used from Suono noise database