Martec Environmental Consultants Ltd.
Waterbrow Wood, Gressingham, LANCASTER LA2 8LX
Tel: 01524 222000
Fax: 01695 768188
Email: info@MartecEnviro.co.uk Website: www.noise.sh

PETERLOO MEMORIAL
VIBRATION ASSESSMENT

Client:
Conlon Construction Ltd
Charnley Fold Lane, Bamber Bridge,
Preston, Lancashire, PR5 6BE

Report Date: 14th December 2018
Ref: 20181214 8507 Peterloo Vib.docx
Site Visit by: M A Kenyon
Monitoring: 13th December 2018

Prepared by: M A Kenyon MSc BSc MIOA



Checked by: D A B Kenyon BSc Hons. CIEH MIOA



Loughborough Office:
8 Bayliss Close,
Quorn, Loughborough, LE12 8PF

Ormskirk Office:
131 New Court Way, Ormskirk, LancsL39 2YT

Staffordshire / Cheshire Office:
2, Betley Hall Gardens, Betley, Crewe CW39BB

CONTENTS

1.0 INTRODUCTION 3
2.0 SITE DESCRIPTION 3
3.0 ASSESSMENT CRITERIA 4
4.0 MEASUREMENTS 6
5.0 RESULTS 7
6.0 ASSESSMENT OF RESULTS 9
7.0 CONCLUSIONS 10
APPENDIX 1 11
APPENDIX 2 12

1.0 INTRODUCTION

At the request of Cumbrian Homes, Martec Environmental Consultants Ltd. undertook an assessment of vibration at the site of the proposed Peterloo Memorial on Lower Mosley Street, Manchester.

It is understood that Manchester City Council are concerned that visitors to the memorial could be disturbed by vibration produced the passage of trams on the adjacent lines.

This report details the results of the vibration measurements made on site, the requirements BS6472-1:2008 and draws conclusions as to the likely acceptability of vibration levels. The consultants' qualifications are set out at Appendix 1 with References at Appendix 2

2.0 SITE DESCRIPTION

It is understood that currently the proposed form of the memorial is an outdoor space, probably in the form of circular, concentric tiers/steps [See Figure 1].

Presumably visitors to the memorial would mainly be standing, although sitting on the steps is naturally also possible. Given the comparatively limited size of the memorial, the maximum duration of stay is probably less than an hour.

The site is located within the city centre and is part of a large paved pedestrian area; between the site and the adjacent tramlines is a large information board; therefore, people are already exposed to the vibration produced by the trams and possibly for similar durations as would occur in future.

3.0 ASSESSMENT CRITERIA

The author is not aware of any vibration criteria relating to outdoor visitors to memorials; indeed, the only guidance relating to humans exposed to vibration, relates to humans being exposed to vibration whilst within buildings, namely BS6472.

Manchester City Council's "Planning & Noise - Technical Guidance – December 2015" states

"A vibration assessment (which is usually based on BS 6472: 2008) may be required where railway/tram lines are within 75m of a proposed development site. It is important that vibration issues are considered, and measurement data supplied in the report, together with mitigation proposals if vibration without these works has been identified as a potential problem".

There is no other information on vibration assessments within MCC Technical Guidance.

3.1 British Standard BS 6472-1:2008

Guide to evaluation of human exposure to vibration in buildings, Part 1: Vibration sources other than blasting, provides guidance as the likelihood of adverse comment from vibration in buildings.

The standard uses the measure Vibration Dose Value or $VDV_{b/d}$, which is derived from frequency-weighted vibration measurements. The VDV is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day, the use made of occupied space (eg. residential, office, workshop, etc), whether the vibration is permanent or temporary (eg. from construction), the broad characteristics (continuous, intermittent, occasional etc), as well as the detailed characteristics (eg. constant/steady, varying in level, impulsive, etc).

The basic criteria of BS 6472-1:2008 are set out below [as amended in Reference 3]:

Table 1: BS 6472: Vibration Criteria

Vibration dose value ranges [$ms^{-1.75}$] which might result in various Probabilities of adverse comment within residential buildings					
Place and time	Adverse Comment is not expected	Low probability of adverse comment	Adverse comment possible	Adverse comment probable	Adverse Comment is very likely
Residential buildings 16h day	<0.2	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6	>1.6
Residential buildings 8h night	<0.1	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8	>0.8

Note: For offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above vibration dose ranges for a 16hr day.

4.0 MEASUREMENTS

Vibration levels are likely to be at their highest during rush hours when more trams run, and are more heavily loaded; in addition, the trams can be longer [2 car] than during off-peak periods. Accordingly, monitoring was conducted during the evening peak period, to establish the highest likely levels of vibration; the vibration transducer was located at the position shown in Figure 1, (shown at the end of the report), on the existing paved surface. An area approximately 3m around the transducer had been cordoned-off to prevent pedestrians passing close to the transducer and causing spuriously high levels.

The site was visited on Thursday 13th December 2018 and the monitoring

took place between 16:00hrs and 19:00hrs.

The vibration analyser used was a SVAN 958 (s/n 69027); simultaneous measurements of vibration were made in vertical [Z axis], and two horizontal directions [along the road [X] and perpendicular to the road [Y]] by means of a Svantek SV84 accelerometer [s/n D2296].

Model	Instrument	Serial No.	Lab Cal Certificate	Date of Lab Cal
H Svan 958A	4 chanel Sound/Vib Analyser	69027	Factory Calibration	22/02/2018
Svan SV12L	Preamp	17060	1400 7741-1	25/09/2017
B&K 4155	Microphone	1479113	1400 7741-1	25/09/2017
RION NC74	Calibrator	34262041	34262041/73203	08/03/2017
Svantek SV84	Tri-axial accelerometer	D2296	14011115	21/11/2018

Table 2: Instrumentation used on Site

The accelerometer was fixed to a heavy steel base plate. The results were filtered using the vertical weighting network “Wb” and "Wd" for the horizontal directions, as appropriate.

5.0 RESULTS

The full results are shown at Table 3.

Date & End time	Duration	X $VDV_{d,1hr}$ [$m/^{1.75}$]	Y $VDV_{d,1hr}$ [$m/^{1.75}$]	Z $VDV_{b,1hr}$ [$m/^{1.75}$]
13/12/2018 16:14:26	00:15:00	0.009739	0.010952	0.00749
13/12/2018 16:29:26	00:15:00	0.010209	0.012417	0.00811
13/12/2018 16:44:26	00:15:00	0.000678	0.012331	0.005888
13/12/2018 16:59:26	00:15:00	0.000516	0.01074	0.006339
13/12/2018 17:14:26	00:15:00	0.000527	0.008913	0.007015
13/12/2018 17:29:26	00:15:00	0.001201	0.004406	0.006005
13/12/2018 17:44:26	00:15:00	0.000494	0.000632	0.00712
13/12/2018 17:59:26	00:15:00	0.000461	0.000596	0.006722
13/12/2018 18:14:26	00:15:00	0.000453	0.000559	0.006427
13/12/2018 18:29:26	00:15:00	0.000442	0.000553	0.006486
13/12/2018 18:44:26	00:15:00	0.000445	0.00057	0.006569
13/12/2018 18:59:26	00:15:00	0.000415	0.000489	0.005041

Table 3: Vibration Results

BS6472 states that the assessment should be performed for the most significant direction. Table 4 below shows the calculated daytime VDV using the formula from BS6472 and factored up as necessary for the shorter measurement period.

Period $VDV = \left(\sum_{n=1}^{n=N} VDVn^4 \right)^{0.25}$

Where VDVn = period VDV values

Period	Day $VDV_{d,day}$ [$m/s^{1.75}$]
Thu 13/12/18	0.03

Table 4: Resultant VDV

Subjective Observations

On installation and collection of the instrumentation, vibration was just perceptible through the soles of the feet when a tram passed-by. No vibration was perceptible for the normal passage of cars, vans, pedestrians etc.

6.0 ASSESSMENT OF RESULTS

The highest measured daytime value of 0.03 $m/s^{1.75}$ Wd. This figure falls into the "Adverse Comment not expected" for daytime vibration from BS.6472-1:2008 [See Table 1 above].

7.0 CONCLUSIONS

The measured vibration levels, whilst perceptible, indicate a resident exposed to such levels in their house for 16 hours/day would not be expected to comment adversely on the vibration. It is not directly applicable to the circumstances of visitors to an outdoor memorial, but it probably does indicate that vibration from the nearby trams should not adversely affect visitors to the memorial.

Please note that it has been assumed that the design and form of the memorial would not increase the existing vibration levels.

APPENDIX 1

QUALIFICATIONS AND EXPERIENCE OF M.A. KENYON

My full name is Melville Alexander Kenyon. I am the principal of the firm of Martec Environmental Consultants Ltd, a consultancy company that specialises in environmental noise assessment and control. I hold a Bachelor's degree in Engineering and a Master's degree in Environmental Acoustics. I am a member of the professional body for noise and vibration specialists, the Institute of Acoustics and have sat on the British Standards Committee dealing with noise in buildings [BS.8233:1999].

My company is on the panel of noise advisers the Clay Pigeon Shooting Association and is a member of The Association of Nose Consultants. I have lectured at Liverpool John Moores University on the Diploma of Acoustics course and at Manchester Metropolitan University on their Environmental Health degree course.

I graduated in 1982 and since that time have experience of dealing with problems caused by noise and vibration, regarding noise and vibration in the environment, the workplace and the home. The firm of Martec Environmental Engineering was formed in the 1970's. Since that time we have advised employers, employees, residents and developers about noise and vibration.

APPENDIX 2
REFERENCES

1 Planning Policy Guidance 24: Planning and Noise. - www.communities.gov.uk/publications/planningandbuilding/ppg24

2 BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings - Part 1: Vibration sources other than blasting"

3 ANC Guidelines "Measurement and Assessment of Groundborne Noise & Vibration - 2nd Edition" - The Association of Noise Consultants 2012

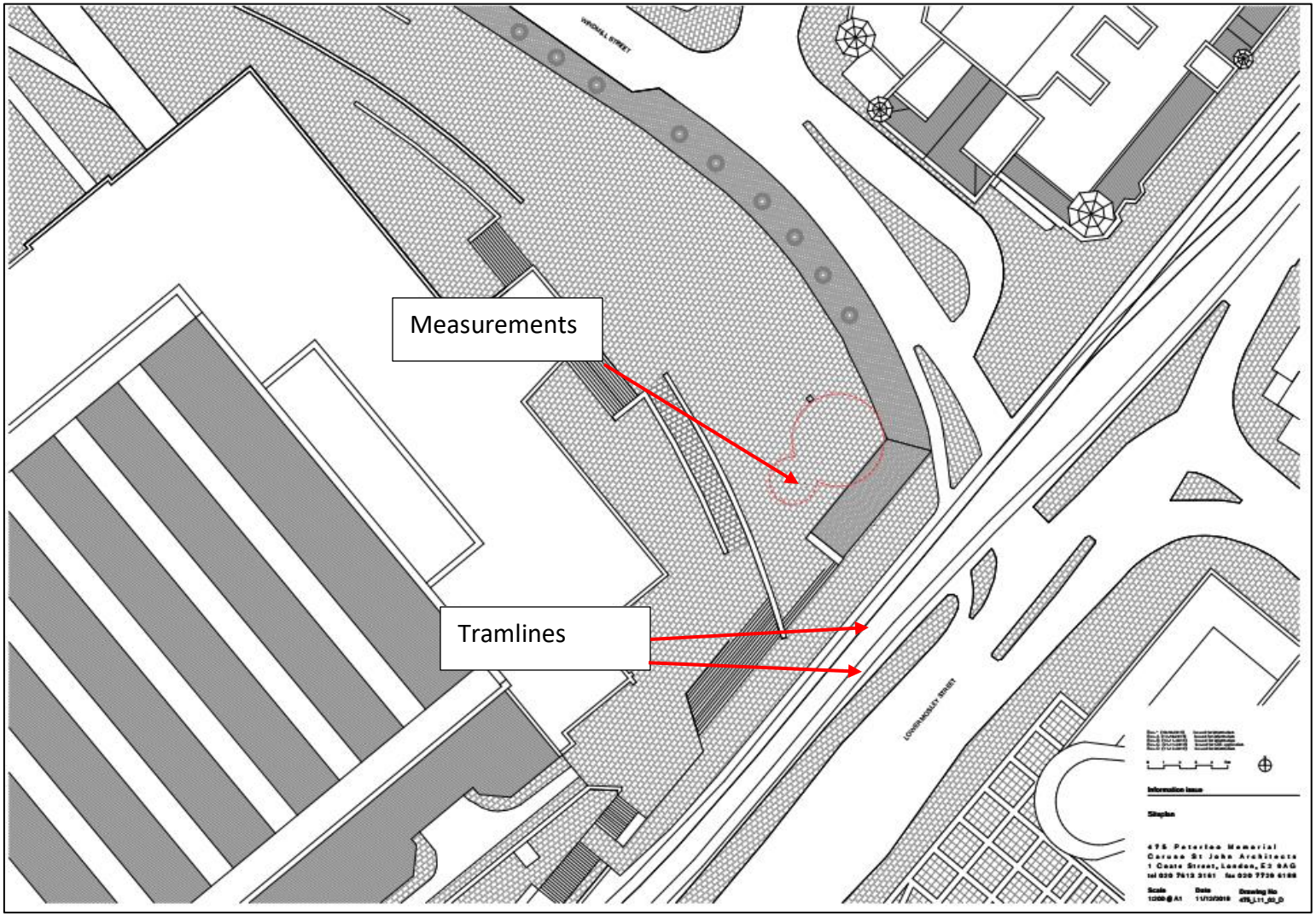


Figure 1: Location of Memorial [red outline] and Measurement and Tramline Location