

Memo

To: MCC, LoR
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Date: 2021 June 10

Project: Noise emission calculation – revision 2
Reference: MF-LAV-XX-XX-RP-YA-01-0039 (T01) – Issued for Tender (LA.170505.M26)

Noise emission calculation appendix 9.4 – update June 2021 (revision 2)

Introduction

This report is an update of the noise emission report of part of “appendix 9.4 of the EIS” from October 2017. The design of The Factory and its surroundings have developed while keeping calculated noise emission within the limits, as shown below. Besides, calculation results are added for the noise from the building services.

Criteria

A key element of the design is to control noise breakout from Factory to its surroundings, in particular the nearby residential areas. The nearest proposed residential building is less than 9m from the venue’s facade.

The following criteria have therefore been set for amplified music in Factory in the previous stages of the project, by Arup and Sandy Brown consultants in conjunction with the MCC Environmental Protection Department (see Factory, Manchester – Environmental Statement Volume 1 – October 2016):

Music

For residential apartment buildings and hotels, the maximally allowed sound levels inside due to amplified music in Factory are 47 dB for the 63 Hz octave band, 41 dB for the 125 Hz octave band.

An attenuation of 5dB through an open window at these low frequencies has been assumed by Arup. Which results in the following criteria on the facades:

The maximally allowed sound level on the façade of residential apartment buildings and hotels is:

- 52 dB Leq for the 63 Hz octave band
- 46 dB Leq for the 125 Hz octave band

Mechanical noise

In addition to the criteria for music noise, the following criteria are set mechanical services noise. These plant noise emission criteria apply to noise sensitive buildings such as residential apartment buildings and hotels only.

The maximally allowed noise level at 1 meter from the façade of noise sensitive buildings due to external plant noise emission by Factory is:

- 50 dB L_{Aeq} during daytime (07.00-23.00h)
- 43 dB L_{Aeq} during nighttime (23.00-07.00h)

Environmental noise modelling

To determine the required sound insulation of the building envelope, with which the above mentioned criteria can be met, a 3D noise model of Factory and its (future) surroundings has been made. For this, environmental noise modelling software Geonoise V4.3 was used. The calculations have been done in accordance with the international standard ISO 9613.

Geometry

Figure 1 shows the 3D noise model of Factory (red) and (future) residential (blue) and other types of buildings (grey).

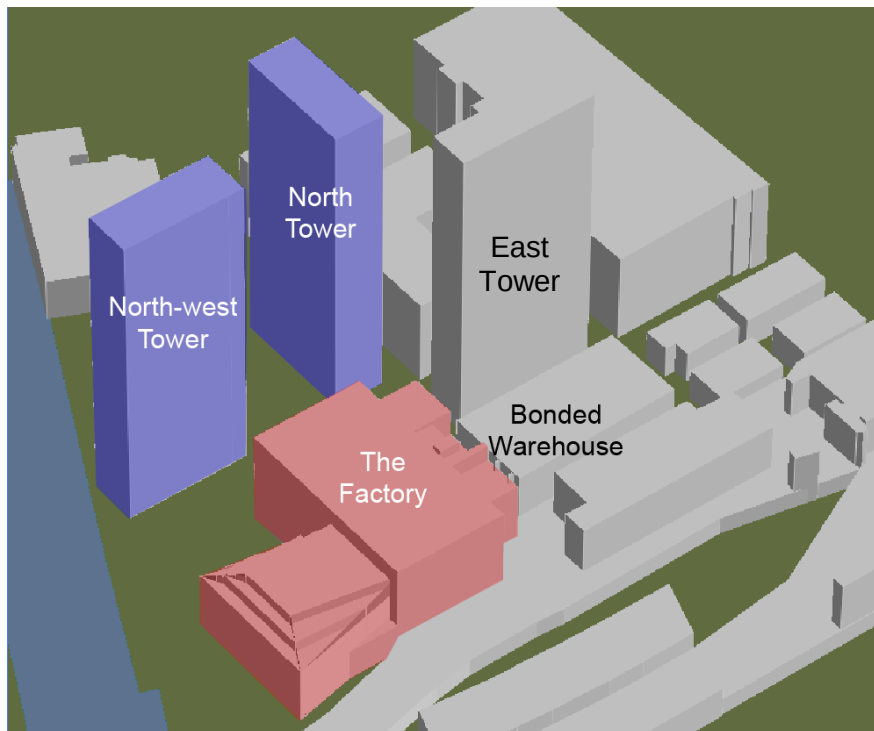


Figure 1: 3D noise model

Sound sources

The following sound sources that dominate the noise emission of Factory have been included in the modelling.

Amplified music in the Theatre and Warehouse

The Theatre and Warehouse will be used for a wide variety of performances. In the most extreme case, three performances can take place at the same time. High sound levels up to 106 dB(A) are to be expected in each space, with a considerable amount of low frequency sound. The acoustic design has been based on the following maximum internal noise production levels and spectra (as stated by Arup in an earlier stage):

Table 1: Maximum sound levels (Leq) for Warehouse and Theatre

	Octave Band Centre Frequency [Hz]								Noise production level dB(A)
Spectrum	63	125	250	500	1000	2000	4000	8000	
Warehouse	110	105	104	104	101	97	93	90	106
Theatre	100	100	104	104	101	97	93	90	106

Simultaneous use of Theatre and Warehouse has been accounted for in the modelling.

Outdoors sound sources, such as cars and trucks and people visiting Factory and its surroundings, have not been taken into account in the calculations of noise egression due to events.

Background music and activities in the foyer spaces

In our modelling we accounted for a sound production level of 80 dB(A) in the foyer spaces, for example sound caused by walking and talking of people, sound coming from bar equipment etcetera. The used spectrum is similar to the Theatre spectrum given in table 1. This implies that background music with limited sound levels may be played. It is assumed that parties with relatively loud music, are assumed not to be planned in the foyer spaces.

MEP and other building services

The air handling and other building services systems are described in document:

MF-LAV-XX-XX-RP-YA-01-0016.

Based on this documents sound power levels of MEP sources are determined and included in the acoustic model.

In the noise emission calculations all MEP sound sources taking into account as running continuously. This is a safe approach.

Building envelope sound insulation

Following from the assumed internal noise levels within Factory and the criteria on the façades of the surrounding buildings, minimum sound insulation requirements have been determined for the various façade, roof and outdoor floor structures, see document MF-LAV-XX-XX-RP-YA-01-0015.

In the 3D environmental noise model, the exterior skin of Factory has been approximated using point sources that have been grouped in order to represent the different façade elements of the building. With this, the minimum sound insulation requirement of each individual façade element was then calculated.

Based on the results the required airborne sound insulation of each façade element (including doors and windows) is defined in terms of:

- R_A for spaces with typical indoor sound sources like the human voice
- R_{Atr} with frequency range 50 - 5000 Hz for spaces with music as a source (enlarged spectrum, according to ISO 717),
- R_{63Hz} and R_{125Hz} for envelope elements that are part of the sound insulating structure around the Theatre and Warehouse.

Detailed noise modelling has also been completed to test the cumulative effect of the noise emission due to simultaneous use of the Theatre and Warehouse, and from all facade elements, at each noise sensitive location. Figure 2 shows a plot of the 3D model with the Factory and its direct surroundings in plan. The red dots show the points on the façades of the residential buildings for which the noise emission levels from Factory have been calculated. For reference, also calculation results for the Bonded Warehouse and East Tower are have been calculated.

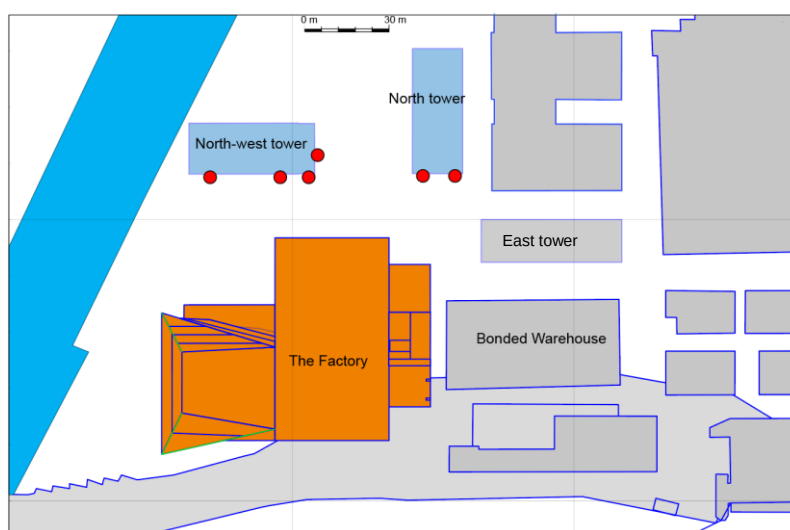


Figure 2: Factory and surrounding buildings (incl. receiving points (red dots) at all relevant heights)

Calculation results

Music performances

In the previous version of this document (2018) results were stated as following:

*"The maximum predicted noise immission level on the façade of a residential apartment building for the **63 Hz octave band is 46 dB**, which is lower than the criterion (max 52 dB)*

*The maximum predicted noise immission level on the façade of a residential apartment building for the **125 Hz octave band is 40 dB**, which is lower than the criterion (max 46 dB)"*

After further design developments, the maximum and average predicted noise immission levels on the façade of the residential towers have been recalculated. The latest calculation results are shown in next table for the 63 Hz and 125 Hz octave band. Also the noise immission levels on the east tower (not residential) and Bonded Warehouse are shown. No criteria are set for these two buildings.

Noise immission levels at tower facades						
	63 Hz			125 Hz		
	max [dB]	average [dB]	criterion [dB]	max [dB]	average [dB]	criterion [dB]
tower north west	48	46	52	46	41	46
tower north	52	49	52	43	41	46
tower east	56	54	-	46	44	-
Bonded Warehouse	62	62	-	53	53	-

The results show that the noise immission level criterion of 52 dB at the 63 Hz octave band and 46 dB at the 125 Hz octave band are not exceeded after further design developments.

MEP noise

The maximum predicted equivalent noise immission levels on the façade of the two residential towers are shown in next table for the daytime (07.00-23.00h) and nighttime (23.00-07.00h). Also the noise immission levels on the east tower (not residential) and Bonded Warehouse are shown. No criteria are set for these two buildings.

Equivalent noise immission levels at residential tower facades				
	daytime (07.00-23.00h)		nighttime (23.00-07.00h)	
	LAeq [dB(A)]	criterion [dB(A)]	LAeq [dB(A)]	criterion [dB(A)]
tower north west	42	50	42	43
tower north	42	50	42	43
tower east	45	-	45	-
Bonded Warehouse	56	-	56	-

The results show that the equivalent noise level criterion of $L_{Aeq} = 50$ dB during daytime $L_{Aeq} = 43$ dB are not exceeded.

Test run smoke exhaust fans and emergency generator

During a test run of the smoke exhaust the maximum predicted noise level on the residential tower facades is $L_{A,max} = 58$ dB. A test run of the emergency generator can cause a maximum noise level of $L_{A,max} = 49$ dB. No criteria are set for these occurrences.