MACH GROUP

GASCOIGNE EAST PHASE 2 BLOCKS E&F

BAFFLED WINDOW DESIGN REVIEW

GEP2-MAL-ZZ-ZZ-RP-X-9011

Willmott Dixon

MACH GROUP

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MACH Acoustics Ltd

Head Office	London Office	
3rd Floor 4 York Court	Eagle House	
Upper York Street	163 City Road	info@machacoustics.com
Bristol	London	www.machacoustics.com
BS2 8QF	EC1V 1NR	
T: 0117 944 1388	T: 0203 488 4559	

Consultants			
	AR	Andrew Rickard	andrew@machacoustics.com
	AB	Archie Byard	archie@machacoustics.com
	AS	Arron Shah	arron@machacoustics.com
	CT	Curtis Thompson	curtis@machacoustics.com
	DB	David Bird	david@machacoustics.com
	JC	Josh Childs	josh@machacoustics.com
	KE	Kyle Edwards	kyle@machacoustics.com
	LH	Laurence Haines	laurence@machacosutics.com
	MR	Max Reynolds	max@machacoustics.com
	PJ	Phil Jordan	phil@machacoustics.com
	SD	Steffan Davies	steffan.d@machacoustics.com
	S	Sujitesh Pillay	suji@machacoustics.com
	WS	William Shen	william@machacoustics.com
	ZN	Ze Nunes	ze@machacoustics.com
	ZE	Zeinab Elamin	zeinab@machacoustics.com
	ZG	Zheng Ge	zheng@machacoustics.com
	TT	Tracy Toal	tracy@machacoustics.com

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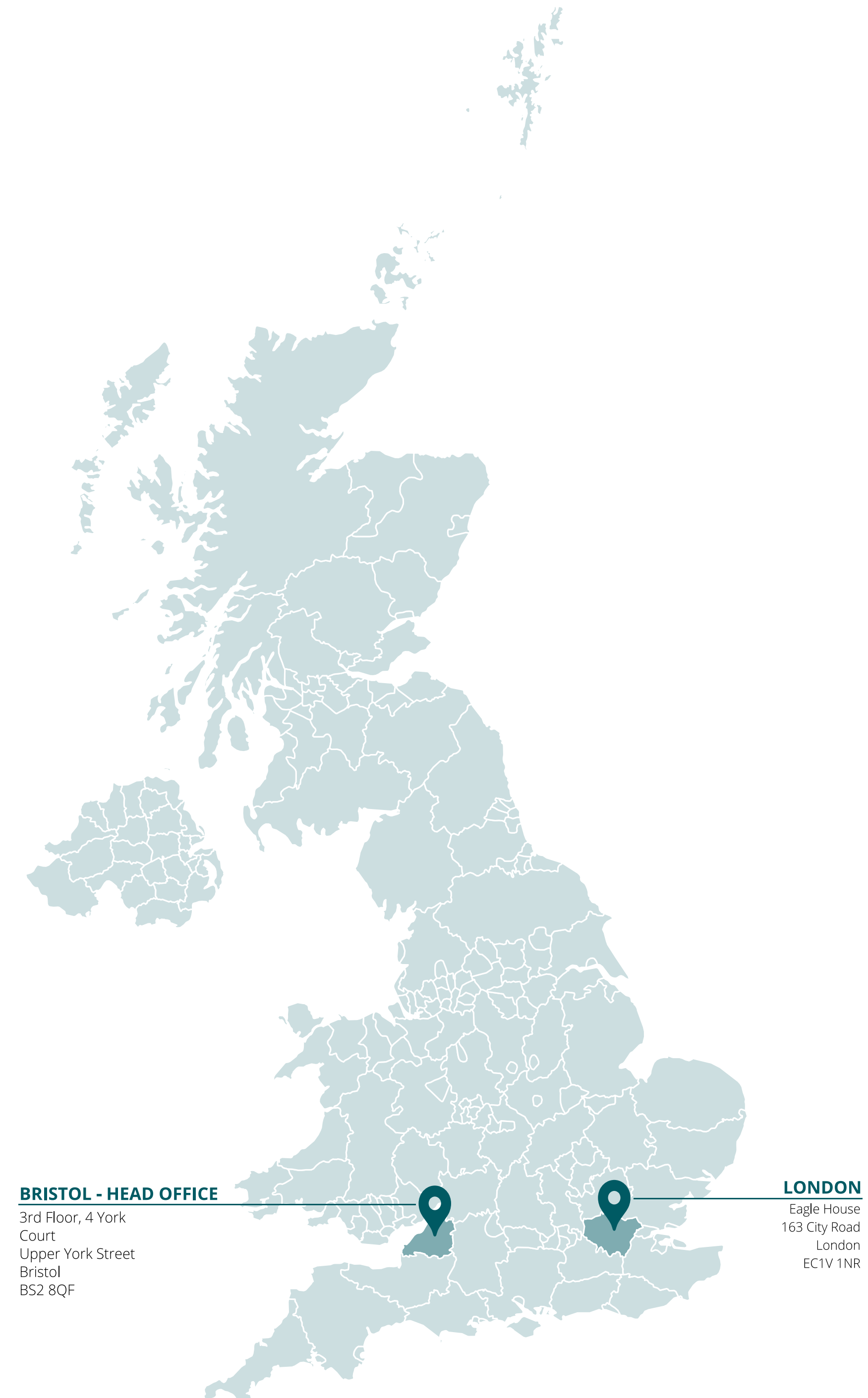


1.0 INTRODUCTION

MACH have undertaken analysis of the proposed baffled windows on the elevations of Blocks E2, F1 and F2. The analysis has comprised of a combination of both analytical modelling and real-world measurements, conducted at The Hive, part of the Building Research Park facility owned by the University of Bath.

The figure to the right shows the window used for the option where the baffle over the window is indicated by the red bubble. As the baffle is placed on the right of the window reveal, It will have a directionality whereby it acts as an acoustic barrier for sound incident from the right, but not from sound incident from the left.

The required open area of the window is taken as the open area of the baffle opening. In other words, the area between the edge of the baffle and window. Please note that although architectural drawings show 175mm a distance of 155mm has been considered as this is understood to be proposed.

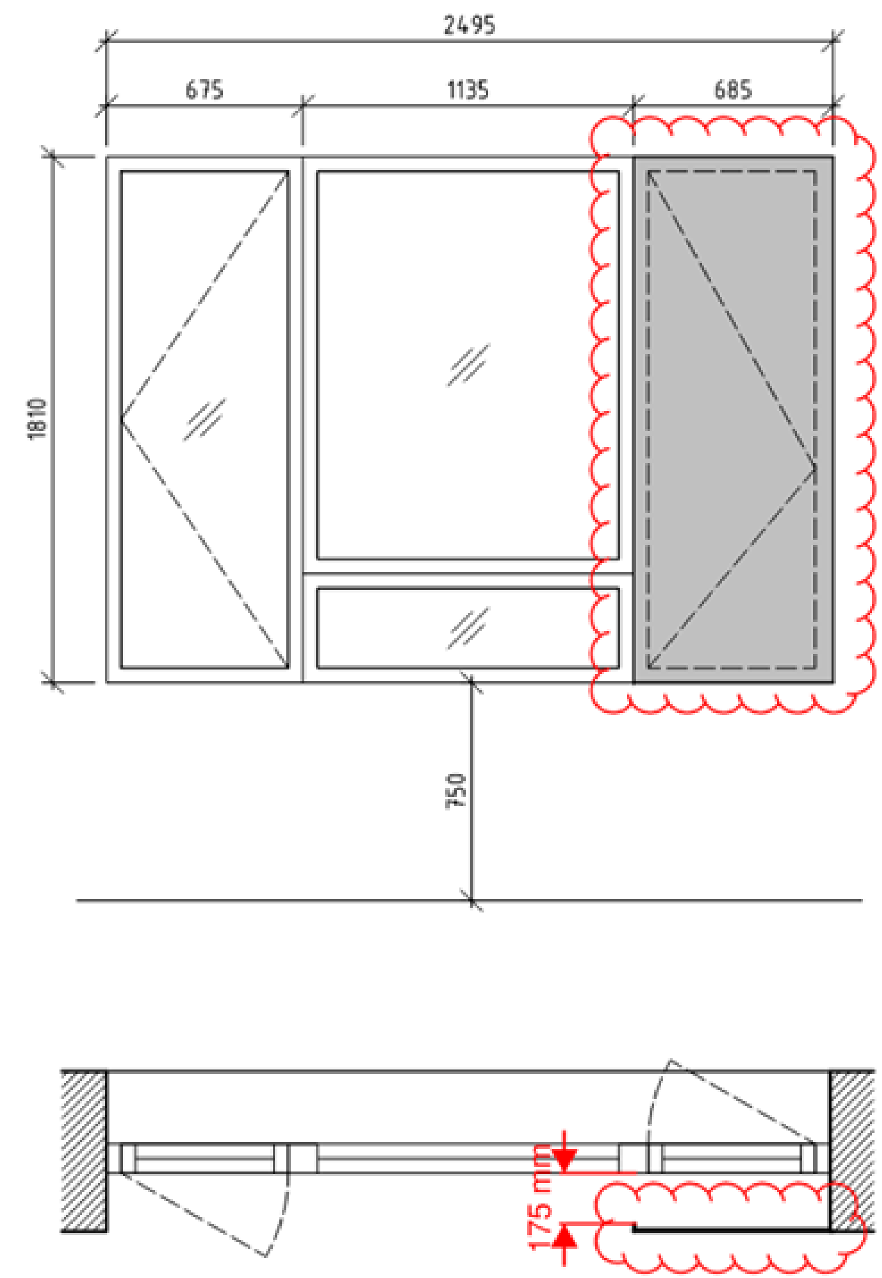


Figure 1.1: Modelled Window

2.0 WINDOW TYPES

The proposed baffled window types are illustrated within the table below and in the Figure 1.1.

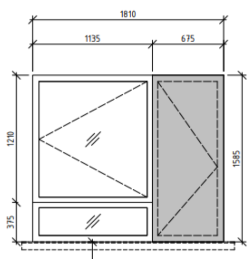
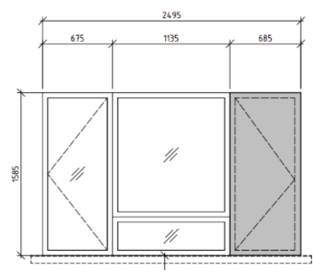
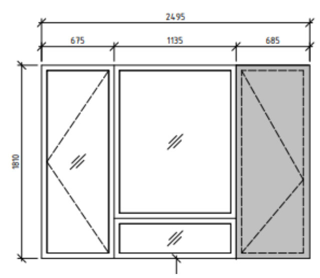
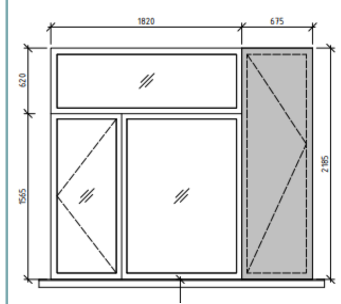
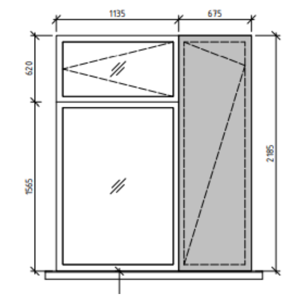
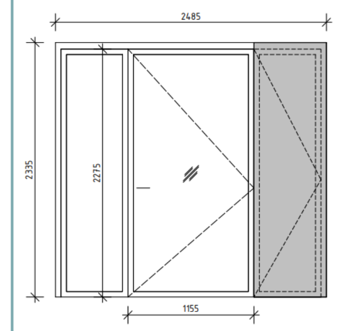
	WE05	WE06	WE13	WE15	WE16	**ED05**
Illustration						
Baffle Distance mm	150	150	150	150	150	150
Effective Open Area m2	0.24	0.24	0.27	0.33	0.33	0.35
Required Window Attenuation dB	20	20	20	20	20	20

Table2.1: Proposed Window Requirements

3.0 FDTD MODELLING

In addition to measurements, MACH has also carried out some preliminary modelling of the baffle in our In-house FDTD (Finite Difference Time Domain) modelling software.

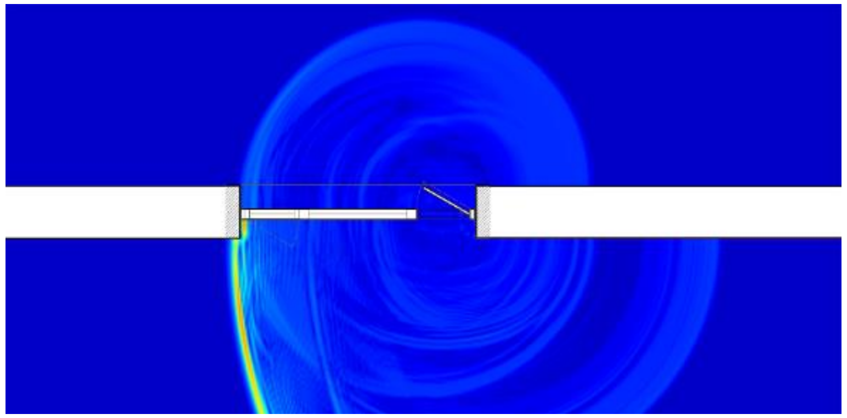
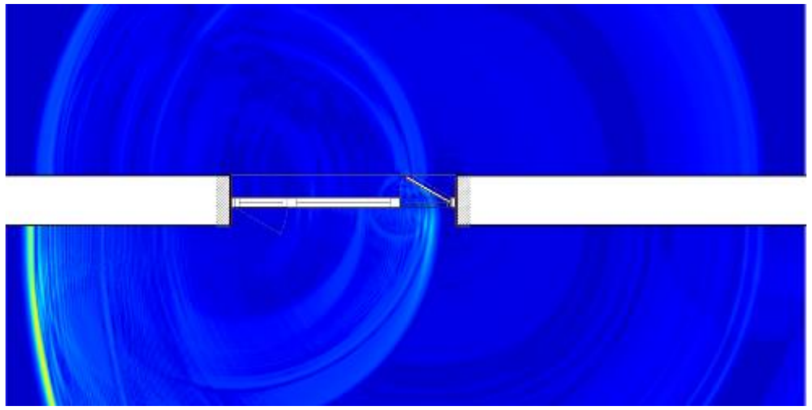
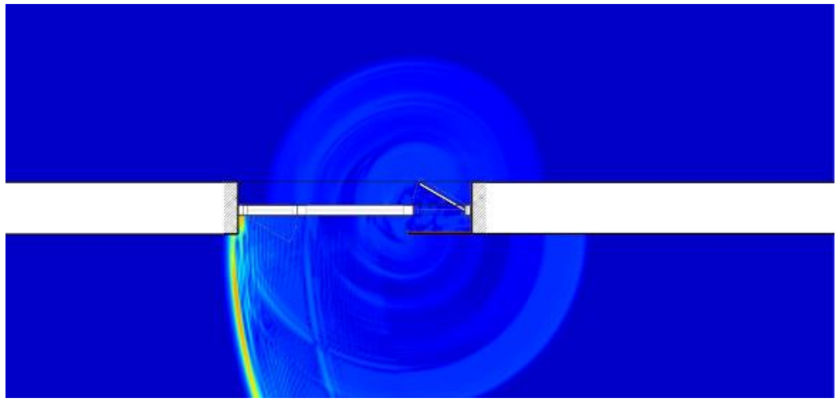
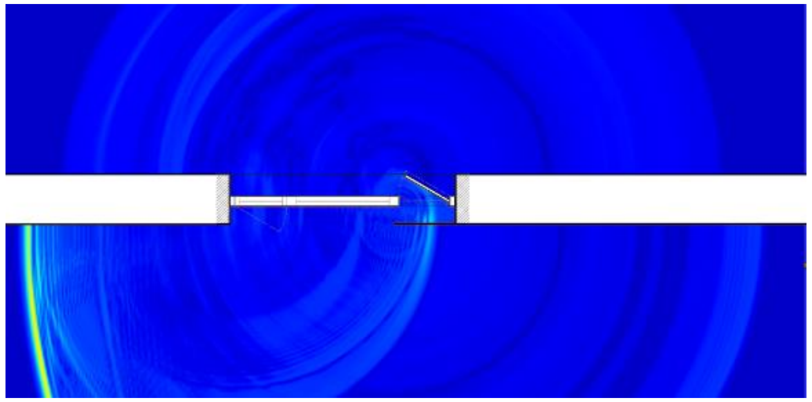
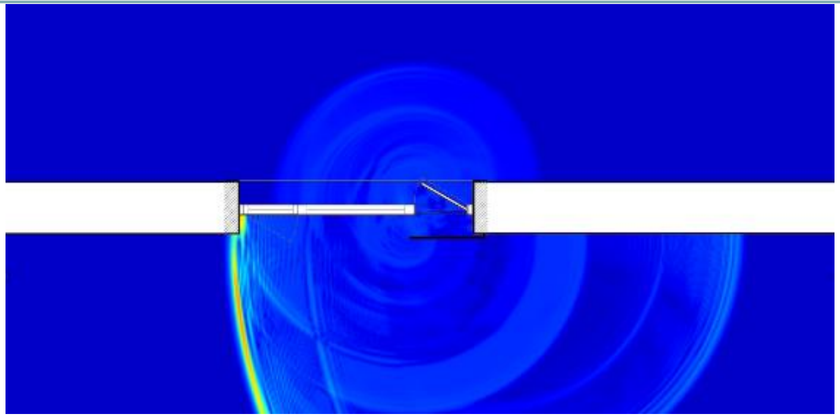
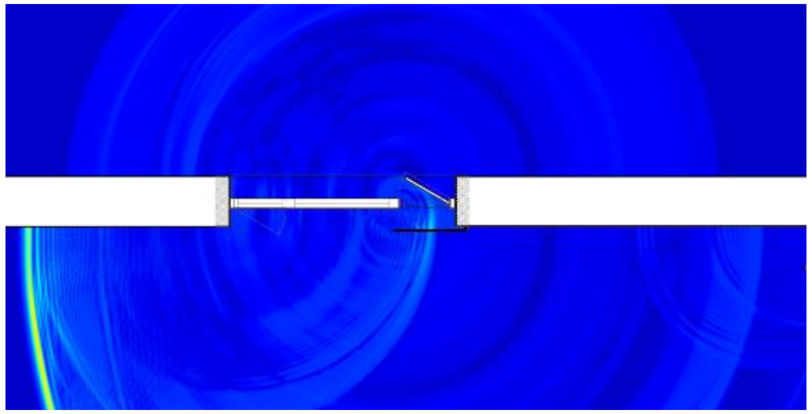
In the images on the following pages, the lighter the colour represents the higher the sound pressure level. Therefore, by using FDTD modelling it can be shown that the addition of the barriers reduces the overall sound energy entering the room.

This modelling tool can therefore be used to illustrate and estimate the improvement of different façade types, shapes or configurations and for different directions of noise source.

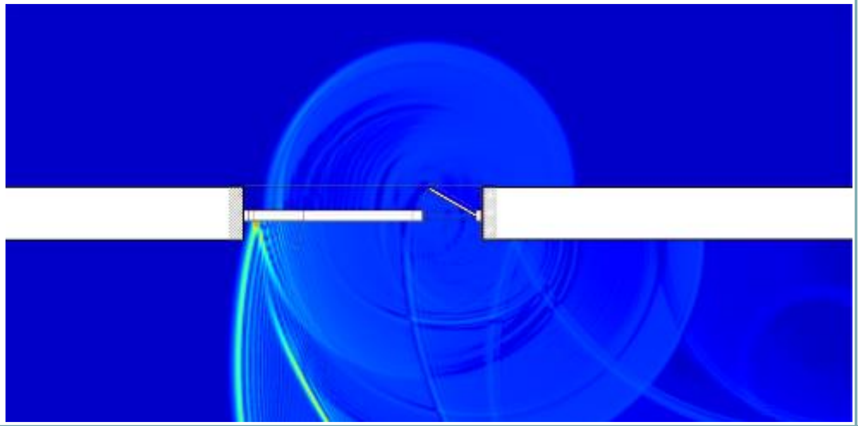
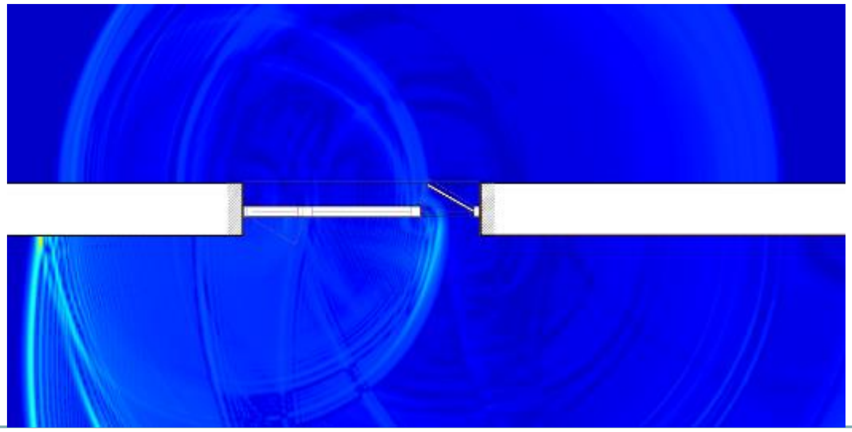
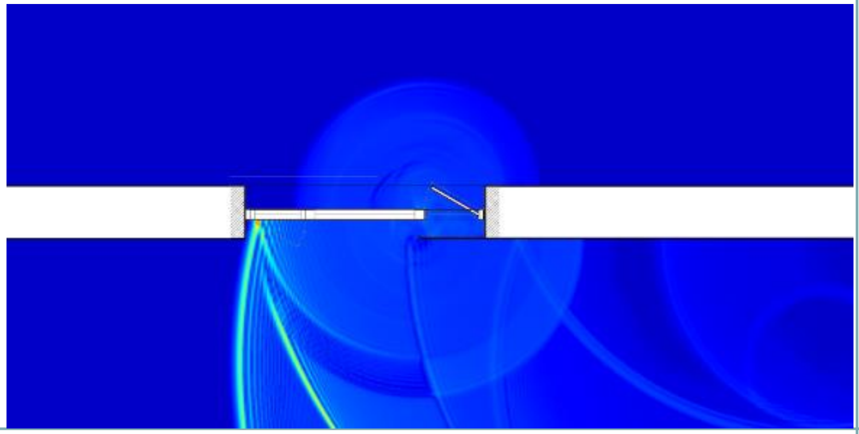
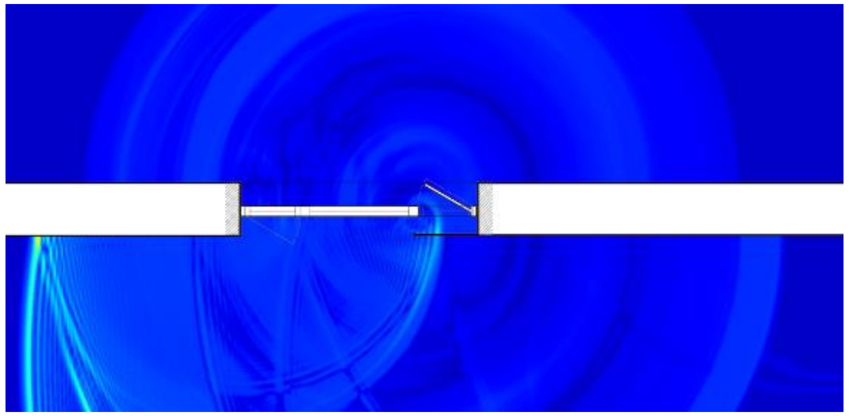
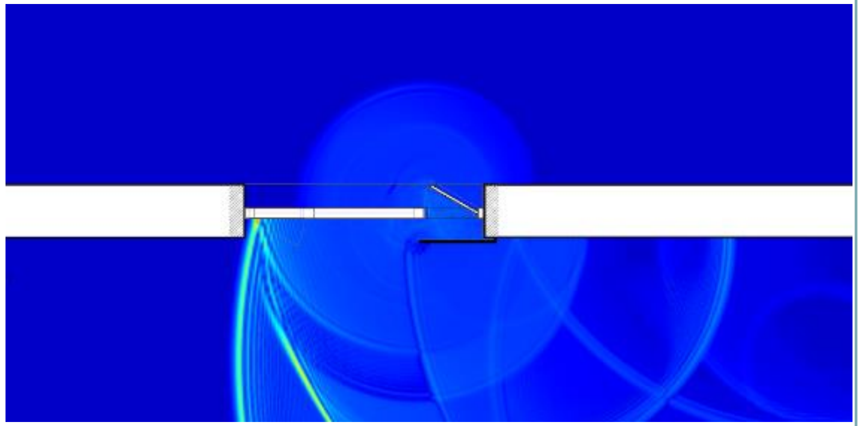
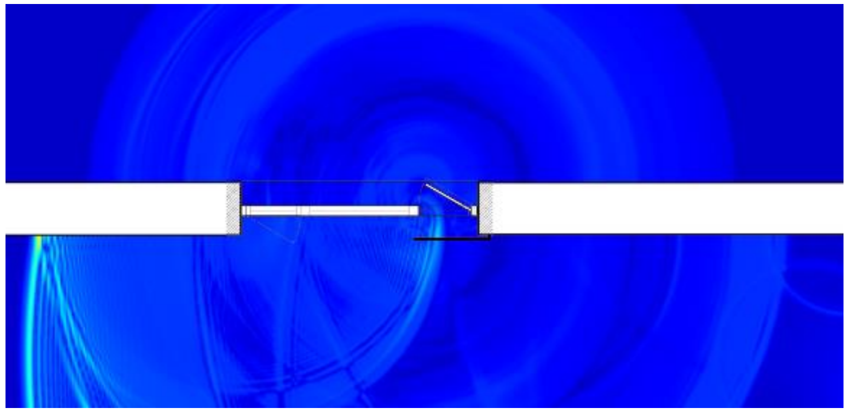
The modelling also shows that by moving the barrier further out and increasing the open area of the baffle, the acoustic screening from the baffle is not drastically reduced.

The modelling was completed with the source at both 70 and 90 degrees to perpendicular to the wall.

3.1 FDTD MODELLING – 90 DEGREES

Model Info	Timeframe 1	Timeframe 2
No Barrier, 90 degrees		
Barrier at 175mm , 90 degrees		
Barrier at 250mm, 90 degrees		

3.2 FDTD MODELLING – 70 DEGREES

Model Info	Timeframe 1	Timeframe 2
No Barrier, 70 degrees		
Barrier at 175mm , 70 degrees		
Barrier at 250mm, 70 degrees		

4.0 LAB TEST SETUP

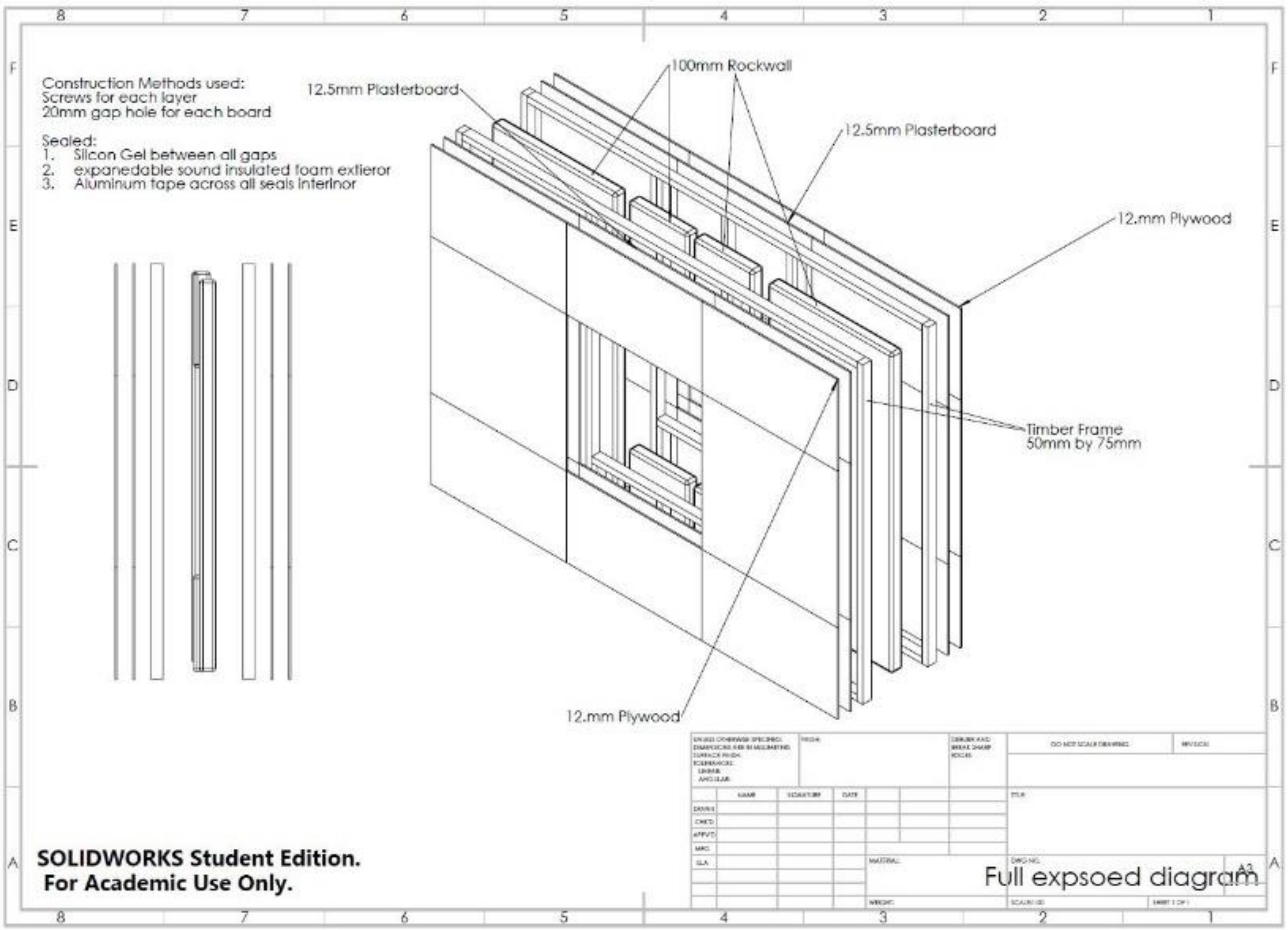


Figure 4.1: Twin Stud Wall Construction at The Hive

To provide further confidence in the acoustic performance of the baffle design for the GEP2 development, MACH have undertaken laboratory tests of a baffled window design.

MACH have bult a model of the proposed window at The Hive. The window is placed within a twin stud wall, constructed as shown.

A window and reveal was then built into the wall and a 685mm x 685mm window was fitted into the reveal, as shown in the following photographs.

4.1 Test Setup Photographs

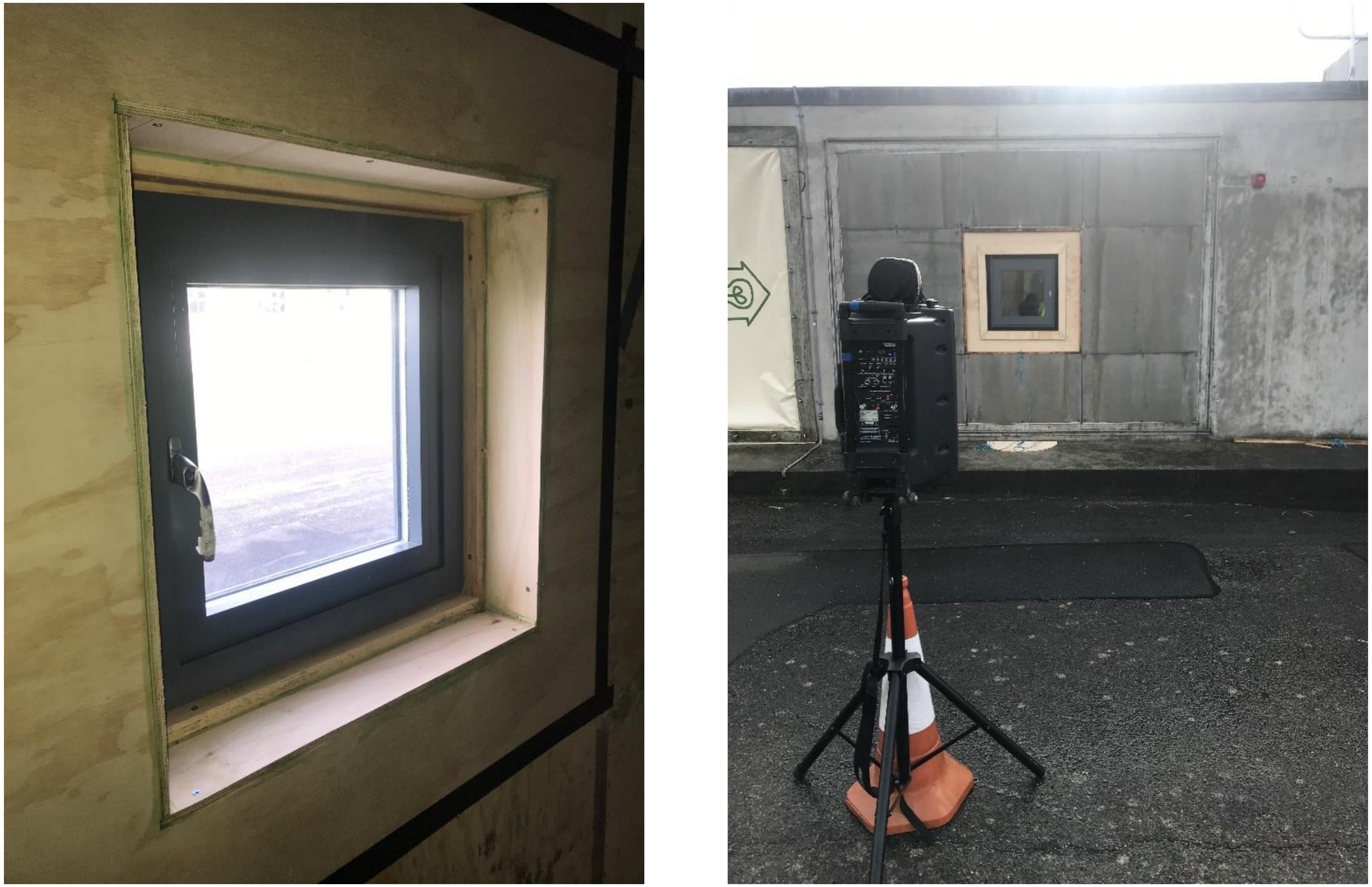


Figure 4.2: Window and reveal construction inside (left) and outside (right)

4.2 Test Setup Photographs

To simulate the baffle in front of the window, a baffle was constructed, leaving a 200mm opening between the window and baffle edge. This is shown below.

Figures 4.3: Window Baffle Construction

5.0 TESTS AND RESULTS

The measurement setup is illustrated in the figure showing the window size and speaker position. The baffled test window (shown on previous slide) had a resultant height of 88cm giving a resultant open area of 0.18m^2.

Tests were undertaken for different window opening distance where it can seen that when the window opening distance is 200mm, the baffle opening is the limiting opening area.

Table 2.1 provides details of the proposed baffled window types where it is seen that the largest window type provides an open area of 0.33m^2.

Whilst the opening area of the baffle is approximately half of that proposed for the largest b affle window size, a correction can be applied to derive the performance of the largest baffle d window type. By applying a 6dB correction, the measured sound reduction is still above that required.

It can be seen that the introduction of a baffle to the window provides a 8dB improvement.

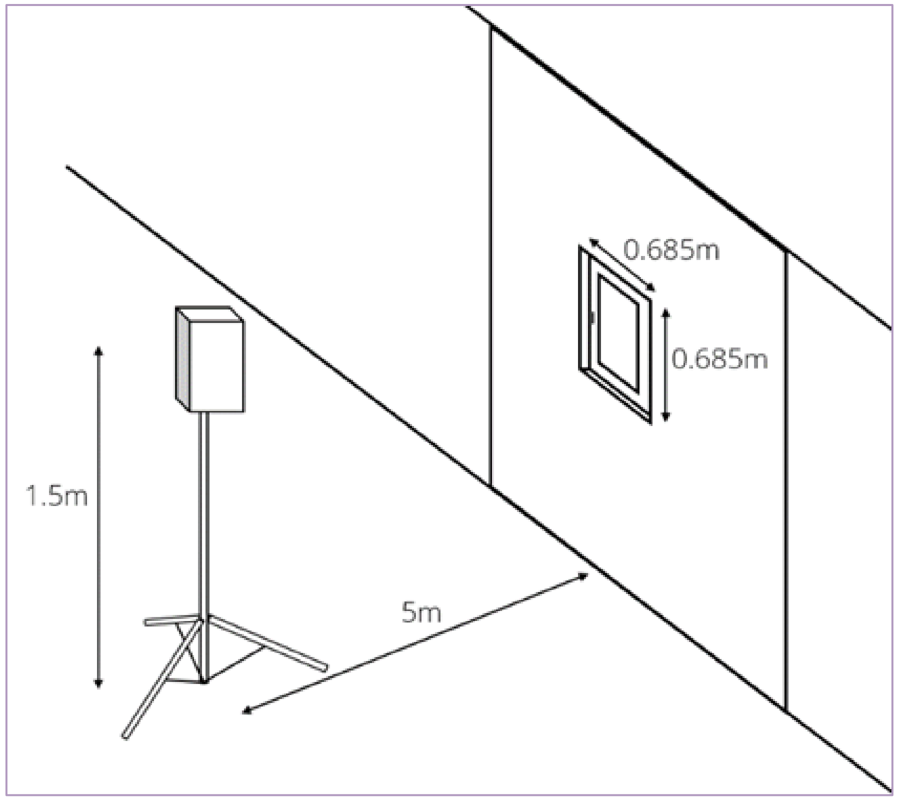


Figure: 5.1: Measurement set-up diagram

Baffle/ No Baffle	Window Open Distance (mm)	Resultant Window Opening Area (m^2)	Measured Window Attenuation (dB)	Measured Window Attenuation, -6dB Correction (dB)
No Baffle	50	0.068	21	15
	100	0.137	20	14
	200	0.273	20	14
Baffle	50	0.068	31	25
	100	0.137	30	24
	200	0.273	28	22

Table 5.1: Hive Window and Window and Baffled Window Test Results

6.0 BAFFLE WINDOW LOCATIONS

MACH have reviewed the architectural elevations with regards to the baffle Location and direction of noise source, where it is seen that all baffles are loca ted in the correct location. The figure below illustrates one of the elevations and direction of noise across the facade.

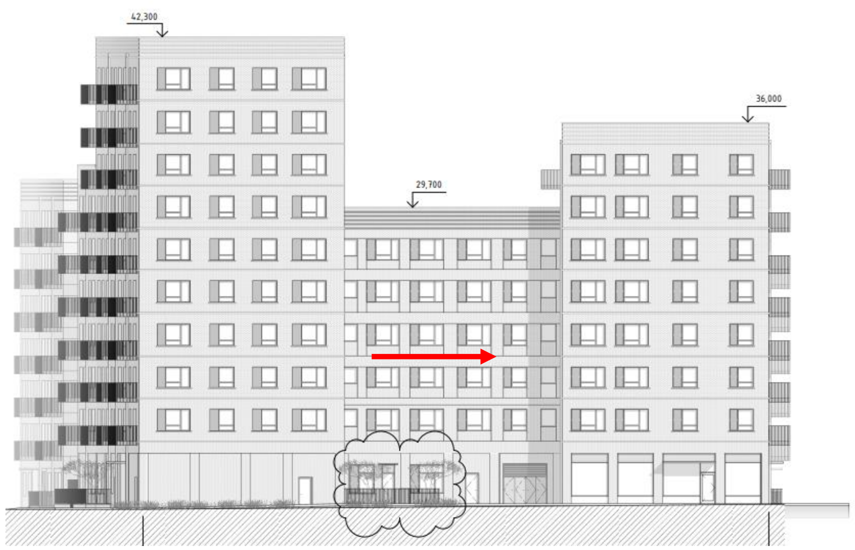


Figure 6.1: North western Elevation Block E2

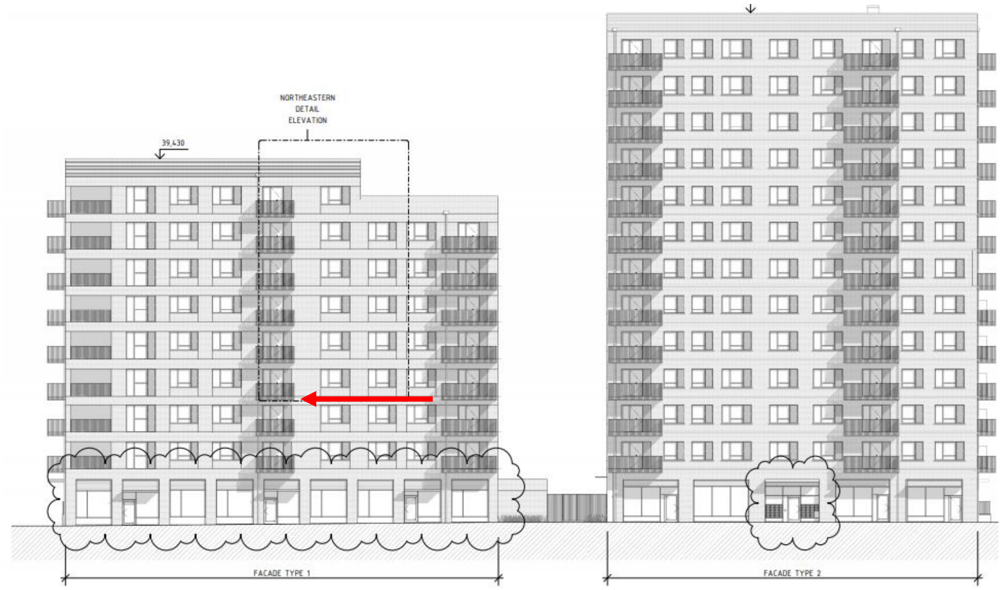


Figure 6.3: North eastern Elevation Block F1

Figure 6.2: South eastern Elevation Block E2

Figure 6.4: South western Elevation Block F1

7.0 OVERHEATING PERFORMANCE WITH BAFFLED WINDOWS

To ensure that the baffled window design will comply with the overheating requirements for this development, the thermal model in IES has been rerun with the opening areas for the different windows types illustrated within Table 2.1.

An early version of the IES model is illustrated in the figure below. The results of the thermal modelling are provided in the tables of the following pages.

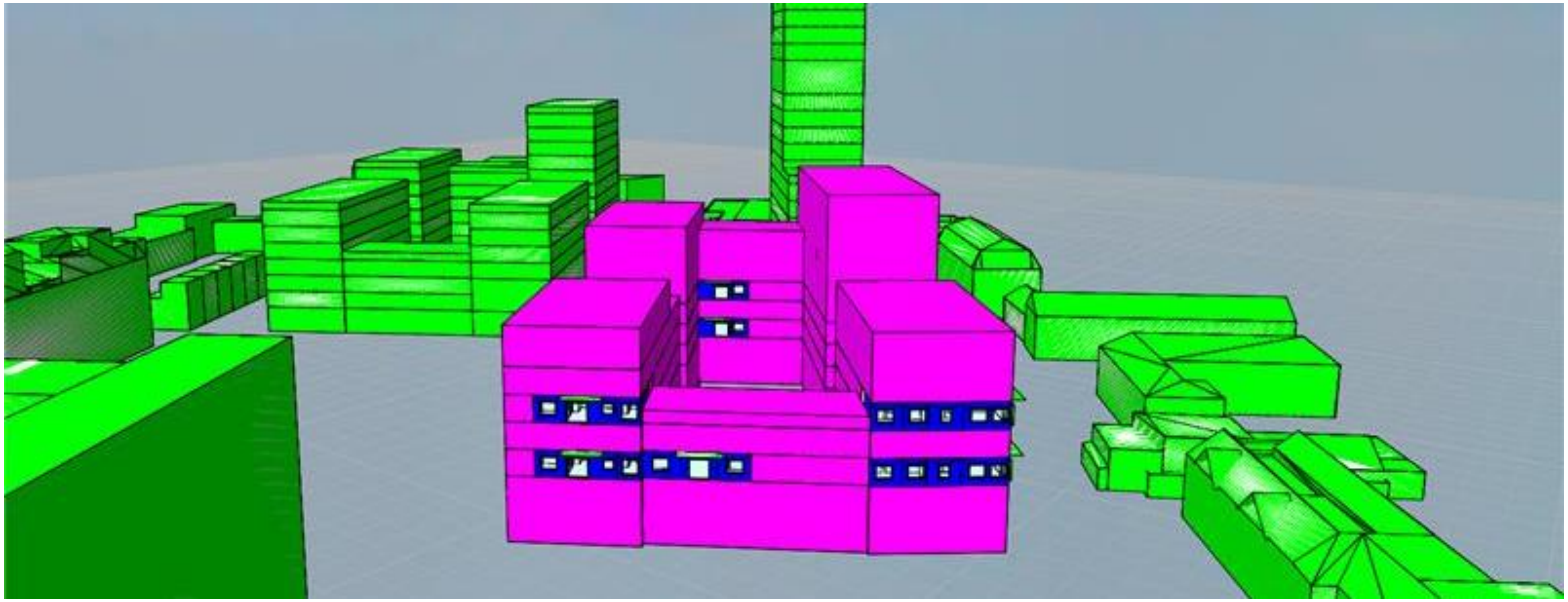


Figure 7.1: IES Model Block E2

7.1 OVERHEATING PERFORMANCE WITH BAFFLED WINDOWS – BLOCK E2 RESULTS

As shown within the table below, it is predicted that all rooms will achieve TM52 compliance with the updated baffle areas within Block E2.

Flat	Room	Ventilation System	Open Area	TM52 Criteria			TM52 Compliant
				Criteria 1	Criteria 2	Criteria 3	
E2.1	Living Room	Openable Windows & MEV	0.4 m^2	1.9	24	3	Yes
	Bedroom 1		0.24 m^2	1.1	29	3	Yes
	Bedroom 2		0.24 m^2	1.4	32	3	Yes
E2.2	Living Room	Openable Windows & MEV	0.6 m^2	2	25	4	Yes
	Bedroom 1		0.24 m^2	1.4	29	3	Yes
E2.3	Living Room	Openable Windows & MEV	0.6 m^2	1.4	22	3	Yes
	Bedroom 1		0.24 m^2	0.9	26	3	Yes
	Bedroom 2		0.24 m^2	0.9	25	3	Yes
E2.4	Living Room	Partially Sealed Façade & MVHR	0.24 m^2	2.4	26	4	Yes
	Bedroom 1		-	0.7	21	3	Yes
	Bedroom 2		-	0.7	21	3	Yes
	Bedroom 3		-	0.7	21	3	Yes
E2.5	Living Room	Sealed Façade & MVHR	-	1.7	21	3	Yes
	Bedroom 1		-	1.1	26	3	Yes
E2.6	Living Room	Partially Sealed Façade & MVHR	0.24 m^2	1.5	24	3	Yes
	Bedroom 1		-	0.8	27	3	Yes
	Bedroom 2		-	0.8	26	3	Yes
	Bedroom 3		-	0.8	27	3	Yes
E2.7	Living Room	Option 1 Openable Windows & MEV	0.6 m^2	1.6	23	3	Yes
	Bedroom 1		0.24 m^2	0.7	21	3	Yes
	Bedroom 2		0.24 m^2	0.6	21	3	Yes
	Bedroom 3		0.24 m^2	1	29	3	Yes

7.2 OVERHEATING PERFORMANCE WITH BAFFLED WINDOWS – BLOCK F1 RESULTS

As shown within the table below, it is predicted that all rooms will achieve TM52 compliance with the updated baffle areas within Block F1.

Flat	Room	Model Scenario	Open Area	TM52 Criteria			TM52 Compliant
				Criteria 1	Criteria 2	Criteria 3	
F1.1	Living Room	Option 1 Openable Windows & MEV	1.0 m^2	1.5	19	3	Yes
	Bedroom 1		0.28 m^2	0.7	19	2	Yes
	Bedroom 2		0.28 m^2	0.9	27	3	Yes
F1.2	Living Room	Option 1 Openable Windows & MEV	0.8 m^2	2.3	27	4	Yes
	Bedroom 1		0.28 m^2	0.9	24	3	Yes
F1.3	Living Room	Option 1 Openable Windows & MEV	0.4 m^2	0.8	22	3	Yes
	Bedroom 1		0.28 m^2	1.3	18	3	Yes
	Bedroom 2		0.28 m^2	0.7	19	2	Yes
F1.4	Living Room	Option 1 Openable Windows & MEV	0.4 m^2	1.4	24	3	Yes
	Bedroom 1		0.28 m^2	1	28	3	Yes
	Bedroom 2		0.28 m^2	0.9	23	3	Yes
F1.5	Living Room	Partially Sealed Façade & MVHR	0.4 m^2 *	1.3	22	3	Yes
	Bedroom 1		-	0.7	23	3	Yes
F1.6	Living Room	Sealed Façade & MVHR	-	1.4	22	3	Yes
	Bedroom 1		-	0.8	27	3	Yes
	Bedroom 2		-	0.8	24	3	Yes
	Bedroom 3		-	0.8	23	3	Yes
F1.7	Living Room	Option 1 Openable Windows & MEV	0.28 m^2	1.5	19	3	Yes
	Bedroom 1		0.28 m^2	0.7	19	2	Yes
	Bedroom 2		0.28 m^2	0.7	19	2	Yes
F1.8	Living Room	Option 1 Openable Windows & MEV	1.0 m^2	1.5	21	3	Yes
	Bedroom 1		0.28 m^2	0.7	19	2	Yes
F1.9	Living Room	Option 1 Openable Windows & MEV	0.8 m^2	1.5	22	3	Yes
	Bedroom 1		0.28 m^2	0.9	25	3	Yes
	Bedroom 2		0.28 m^2	0.8	22	3	Yes
	Bedroom 3		0.28 m^2	0.7	21	3	Yes
F1.10	Living Room	Option 1 Openable Windows & MEV	0.6 m^2	1.5	19	3	Yes
	Bedroom 1		0.28 m^2	0.9	27	3	Yes
	Bedroom 2		0.28 m^2	0.7	19	2	Yes
F1.11	Living Room	Option 1 Openable Windows & MEV	0.6 m^2	1.4	22	3	Yes
	Bedroom 1		0.28 m^2	0.8	25	3	Yes
	Bedroom 2		0.28 m^2	0.9	24	3	Yes

* Openable windows located on courtyard-facing façade only

8.0 CONCLUSION

A baffled window design has been proposed for the Gascoigne East Phase 2 development and in particular for blocks E2 and F1.

The purpose of the baffled window, is to enhance the performance of the window on higher noise facades in order to reduce the mechanical ventilation needs.

In order to assess the baffled window performance, MACH have used in house FDTD modelling tools to predict and illustrate the acoustic benefit of this design. To further support this modelling and provide greater confidence in baffle performance, MACH have undertaken acoustic testing at the University of Baths Hive building test facility.

The test results confirmed that the proposed baffle design would meet the acoustic requirements for the baffled window design considered on this project and will provide an improvement of +8dB over a standard openable window.

The assessments show that by increasing the distance of the baffle to the window does not drastically increase the amount of sound energy entering the room.

In order to ensure that the overheating requirements are also met for this development, the overheating models have been run with the proposed baffle open area such to ensure compliance with TM52. The results of this modelling identified that the compliance with TM52 would be achieved in all instances.

It is therefore considered that the baffled window design meets both the acoustic and overheating requirements for a distance of 150mm or 175mm from the window.