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Dear Sirs

Reference : Units at Maesgwyn Road Wrexham LL11 2AP

With reference to the above development and Condition 5 in the Planning Approval (WRO P/2016/0299) for the change of use of the premises from a Workshop to a Self Storage facility.

Before detailing the work required it is worth noting the following requirements :

When this kind of work is undertaken, there is a duty on the developer to specify methods and materials of construction to ensure compliance with the Noise Insulation aspects of the current Building Regulations (Approved Document E). The Approved Document E provides guidance on "typical" constructions that should provide the required noise insulation but does not specify exact materials.

Inevitably, the constructions used in build work cannot always comply exactly with the Regulation guidance since existing materials and structures often need to be used in order to be economically viable. Therefore, there is a provision in the current Building Regulations for the Local Authority Building Control Officer to require a Pre-Completion Test (PCT) to ensure compliance with the Regulations.

Technical Background

A major revision of the Building Regulations Approved Document E on Sound Insulation came into force on 1st July 2003. The previous 1992 Regulations have been extended to include rooms for residential purposes, the insulation of internal walls, reverberation in multiple occupancy dwellings and a new section on schools. Levels of sound insulation between domestic dwellings were stated which were deemed to be "reasonable" and methods of achieving these were suggested. Acceptable levels were specified for both New Build and for Conversions. Most importantly, a new requirement for Pre-Completion Testing (**PCT**) has been added.

For **Airborne Noise**, the actual performance levels chosen were expressed in terms of a new parameter, DnTw + Ctr, the Weighted Standardised Level Difference corrected for low frequency noise. The parameters DnTw and Ctr are defined in BSEN ISO 717. The basic parameter DnTw is the value of the Rating Curve at 500Hz. The Rating Curve is arrived at by taking the difference between the level of a Standard Source noise in one room and the residual level in a corresponding Receiving Room and correcting for Reverberation Time and Background Noise. This is then compared with a Standard Reference curve using the methods of BS EN ISO 717. The DnTw value is then corrected for low frequency using a calculation for the Ctr term. The previous 1992 regulations used only the DnTw parameter.

The minimum airborne insulation level required for floors is:- **45dB DnTw + Ctr** for New Build and **43dB DnTw + Ctr** for Conversions. These values are numerically smaller than the value for DnTw in the previous Regulations since the Ctr term is a negative value. A higher value suggests better noise insulation.

For **Impact Noise**, the actual performance levels chosen in the new regulations continue to be expressed in terms of the previously used parameter, LnTw the Weighted Standardised Level Difference. The parameter LnTw is defined in BSEN ISO 717. The basic parameter LnTw is the value of the Rating Curve at 500Hz. The Rating Curve is arrived at by measuring the level in the Receiving Room of a Standard Impact machine operating on an uncovered floor in the source room and correcting for Reverberation Time and Background Noise. This is then compared with a Standard Reference curve using the methods of BS EN ISO 717. The LnTw value is not corrected for low frequency using the Ctr term.

The maximum acceptable impact level permitted for floors is:- **62dB LnTw** for New Build and **64dB LnTw** for Conversions. In this case, a lower value suggests better noise insulation.

Methods for carrying out the tests are defined in BS EN ISO 140. For field tests, the tests should be carried out on unfurnished rooms .

In addition there is a requirement that Internal Walls should achieve an $R_w = 40$ dB. A higher figure suggesting better noise insulation.

There can be confusion between the attenuation figures quoted in literature :

$DnTw + Ctr$: this denotes a FIELD measurement – this figure is ALWAYS lower than the R_w attenuation quoted because it is a field measurement on partitions built on site.

The Ctr term is a correction for low frequency performance of the partition, this has become more important with the advent of high-powered music systems.

It is important to note that the 'Building Regulations' denote this term the *apparent sound insulation* between rooms – this not only takes into account the attenuation (or lack of it) of the party wall but also any acoustic leakage paths (flanking transmission) between the two properties – **this is why it is very important to correctly seal the wall to the floor, ceiling and outer walls.**

R_w – this figure is quoted by manufactures of building elements (and is the only one they can quote as they are not responsible for the building of the various elements into the final structure) and is obtained by LABORATORY measurements – it will ALWAYS be greater than the $DnTw + Ctr$ figure because in the lab. measurements there is no flanking transmission – and the building elements are always correctly fitted in the aperture.

The Approved Document E guidance does not state a requirement for the situation of a commercial premise to a dwelling but suggests that “specialist guidance be sought”. Building Control Departments generally hope to see a better performance figure than that for Conversions. The New Build figure is often seen as a minimum target.

Floor / Ceiling

The present ceiling / floor in the offices is formed from a concrete slab approximately 125 /150mm thick - the approximate mass of this slab will be of the order of 300 / 350 kg /sq m.

If this is the case then the airborne attenuation achieved by the present floor / ceiling could be of the order of 45 - 50 dB - however the slab will offer no Impact attenuation between the First Floor and Ground Floor apartments.

In order to achieve the required Impact attenuation then an independent false ceiling should be fitted to the Ground Floor apartment.

The support beams for this ceiling should be mounted off wall brackets - on no account should the walls be cut out in order to support the beams.

The distance between the existing ceiling and the new ceiling should ideally be 150mm - the void created being in filled with 100mm thick mineral fibre sound insulation material having a minimum density of at least 10 kg / cu m.

If the span of the beams is such that support is required then this must be achieved by using resilient hangers (cmsacoustics.co.uk) - on no account must any supports be rigidly fixed.

The ceiling is then treated with a double layer of 12.5mm plasterboard and skim finished to 3mm.

The above treatment will also increase the attenuation offered by the floor so that potentially it could be in the range 50 - 60 dB - and has previously achieved the required standard on Impact Attenuation.

Garage

Under a First Floor apartment is an internal garage to be used by the residents of the building - whilst the ceiling in the garage will have to be 'fire rated' the attenuation of the ceiling / floor will need to be increased.

In addition access will be via a Roller Shutter door - this must be an electric door and kept in a well maintained condition.

The internal noise level within the garage is difficult to estimate but from previous measurements undertaken in commercial garages where cars have been moved around levels of the order of 78 dBA (Canterbury MOT Station Blackburn).

If the garage is fitted with a false ceiling as detailed above with the exception that the 12.5mm plasterboard is replaced with a double layer of 15mm Gyproc SoundBloc (or similar) and that the mineral fibre sound insulation is increased in density from 10 to 33 kg / cu m then the estimated attenuation of this ceiling - from previous measurements - will be of the order of 55 - 60 dBA.

As there is no requirement for Impact Attenuation between the residential apartment and the Garage then the false ceiling can be rigidly mounted onto the existing ceiling.

If this is the case then the internal level within the residential rooms over the garage could be of the order of 78 - 55 = 23 dBA.

It should be remembered that the noise from the garage will not be continuous.

First Floor Ceilings

The actual roof of the building is constructed from a Kingspan type panel - the actual panel type is unknown - however a potential problem could be 'rain noise' on the roof increasing the noise level within the First Floor apartments.

Rain Noise

It is stated that the indoor ambient noise level during 'heavy' rain should not exceed the 65 dBA.

With respect to the above the Criteria for noise intrusion from external sources is quoted as :

Bedrooms 30 dB LA eq

Below is calculated the likely noise level of the effect of rain noise on the Bedrooms on the First Floor – this is taken as the *worst case situation* – therefore the requirement is for a calculated noise level less than **LA eq1hr = 65 dB**.

The noise level within the Ceiling Void can be calculated using the following :

$$L_{pr} = L_{wref} + 10\log T - 10\log V + 14 + 10\log S \text{ dB}$$

Where :

L_{pr} = rain noise level in room – dB

L_{wref} = sound power level – when 1 m² of roof is excited) dB

T = Rev time = see below

V = Room volume = 290 cu m (estimated)

S = Surface area of roof = 165sq m (estimated)

Sound Absorption Coefficient

	Area sq	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Surface						
Ceiling	58.4	0.5	0.6	0.8	0.8	0.8
Roof	165	0.1	0.01	0.02	0.02	0.03

Absorption Area sq m

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Surface					
Ceiling	29.2	35	46.7	46.7	46.7
Roof	16.5	1.65	3.3	3.3	4.95
Total Absorption Area	45.7	36.65	50	50	51.65

Calculated Reverberation Time $T = 0.16 V / A$ seconds

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
T seconds	1	1.26	0.92	0.92	0.89

Therefore :

$$L_{pr} = L_{wref} + 10\log T - 10\log 290 + 14 + 10 \log 165 \text{ dB}$$

$$L_{pr} = L_{wref} + 10 \log T + 11.5$$

Octave Band Centre Frequencies Hz								
	63	125	250	500	1000	2000	4000	8000
Sound Reduction Index R	50	49	52	53	53	45	38	30
From formulae	+11.5	+11.5	+11.5	+11.5	+11.5	+11.5	+11.5	+11.5
10 log T			0	+1	-0.3	-0.3	-0.5	
'A' Weighting Correction	-	-	-8.6	-3.2	0	+1.2	+1.0	-
Resultant	-	-	54.9	62.3	64.2	57.4	50.0	

Overall 'A' weighted level = 67 (67.2) dBA

However the above calculated noise level is that within the ceiling void rather than the rooms on the First Floor - if the ceilings are treated with a double layer of 12.5mm Gyproc SoundBloc plasterboard - the quoted attenuation of which is 43 dB then the internal level within the rooms could be of the order of 24 dBA

It is worth noting that the 'heavy' rain described above simulates a rainfall rate that occurs once in every 50 years!

However as the party walls between the apartments are unlikely to be built up to the underside of the external roof they are very likely to be double boarded for fire reasons - the double boarding should use 12.5mm Gyproc SoundBloc (or similar).

If this is used the attenuation between the rooms - across the ceilings - could be of the order of $R_w = 46$ dB.

As can be seen this is within the requirements of the internal levels quoted in BS 8233 : 2014.

Soil Pipes

If these are to run internally through the apartments then care must be taken to ensure that there is a minimum of noise breakout into the apartments.

The pipes themselves must not be rigidly fixed to the structure of the building – they must be resiliently mounted and the actual pipes completely wrapped in at least 50mm mineral fibre insulation.

They should be encased with a studded framework that does not come into contact with the pipes and is finished with a double layer of 15mm Gyproc SoundBloc / Lafarge E plasterboard.

Any holes that are cut into the floors and walls must be fully filled with high density filler

The use of expanding foam to fill any holes must NOT be allowed.

Stairwells

It is possible that the reverberation time in the common areas will be required to meet that laid down in BB93

From Table 1.5 in BB93 it is recommended that in 'circulation areas' the reverberation times should be no greater than 1.5 secs. averaged over the mid frequency range 500 Hz, 1000 Hz and 2000 Hz.

A stair carpet and its underlay will provide absorption : the amount of absorption provided depends on the area of the carpet and the absorption coefficient of the carpet at the frequencies of interest.

At this stage is difficult to calculate the actual absorption that will be present in the stairwell area – however we would recommend that a good quality carpet underlay be fitted together with a good quality thick carpet – this may be sufficient - this will also have the advantage of reducing the Impact Noise from the use of the stairs.

However this may need to be supplemented by the addition of an 'office style' acoustic ceiling to the common hallways and stairs

General Notes

The success of the above systems will depend upon the care that is taken in the building of the various elements of the development – the systems recommended have passed the PCT on other sites.

At all times the manufactures fitting instructions **MUST** be followed.

All fixings **MUST** be as per the manufacturer's instructions.

All screws used **MUST** be of the correct length – to ensure that the resilient layers are not flanked.

It is very important that ALL holes are sealed with high density filler - **the use of expanding foam to fill any holes must NOT be allowed.**

WALLS

Apartment Walls to B2 Workshop

Essentially there are two such walls - the one immediately adjacent to the access door to the B2 Workshop and the other the 'rear' wall of the residential apartments to the B2

The wall immediately adjacent to the access door is a solid masonry wall approximately 300mm thick - this wall is immediately adjacent to the Garage on the Ground Floor but adjacent to a Bedroom of Apartment 1 on the First Floor.

The B2 Workshop will be open from 08.30 until 17.00 hrs - and delivery will be via the large Roller Shutter door that opens onto Maesgwyn Road - from previous internal measurements within a Workshop (Thumbs Up - Bury) an overall noise level of 74 - 78 dBA measured.

The attenuation of this wall is difficult to estimate but from experience we would expect it to be of the order of 55 - 60 dBA - if this is the case then the internal level in the adjacent Bedroom could be of the order of 18 - 23 dBA which is well within the requirements of BS 8233 : 2014 - therefore no additional treatment will be needed to this wall.

The wall to the rear of the apartments is a brick wall approximately 200mm thick but with existing windows and doors in the walls - these need to be in filled with brick / blockwork to at least the standard of the existing wall - light weight blocks must not be used.

There is a gap between the existing rear wall and the roof of the building - this needs to be in filled with a high density sealer - on no account must light weight expanding foam be used.

As the attenuation of the rear brick wall could be of the order of 45 dBA (New Build Standard) then the internal level within the habitable rooms could be of the order of $78 - 45 = 33$ dBA - this is in excess of the requirements of the current Building Regulations.

It is therefore recommended that an independant studded wall be constructed - adjacent to the existing wall - the cavity created is then in filled with 100mm mineral fibre sound insulation material with a minimum density of 10 kg / cu m and the studded wall finished with a double layer of 12.5mm plasterboard.

Due to the size of the wall it may well be necessary to tie the studded wall into the existing wall for support - this is not ideal but if it is necessary then the number of ties should be kept to a minimum.

Whilst it is impossible to give exact attenuation figures for the above construction we would expect - from experience - that the overall attenuation of the structure will be increased to around 55 dBA - if this is the case then the internal levels within the apartments will comply with the requirements of BS 8233 : 2014.

Party Walls within the Apartments

Due to the good design of the apartments there is only a party wall between the Lounge of Apartment 1 and the Bedroom of Apartment 2 on the First Floor.

This wall should be constructed as follows :

A double independent studded frame of either timber or metal with the cavity in filled with 50mm mineral fibre sound insulation material having a minimum density of 10 kg / cu m - the studding is then lined either side with a double layer of 12.5mm Gyproc SoundBloc plasterboard (or similar).

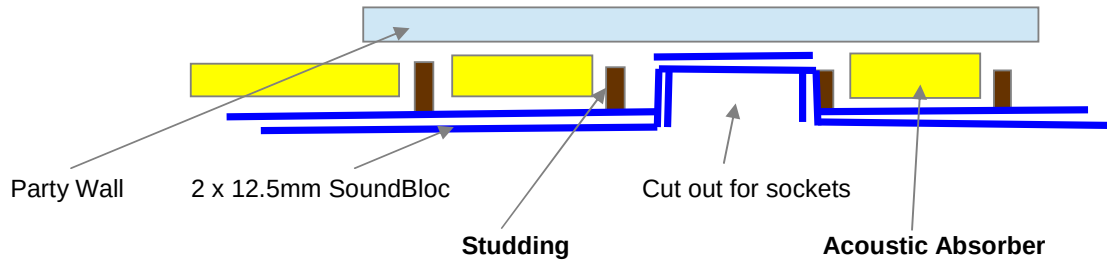
This construction should ideally be used for the party wall of the Lounge / Kitchen in Apartment 1 to the entrance Stairwell of Apartment 2 and the Stairwell to the kitchen / bathroom of Apartment 1.

Electrical Sockets

Ideally electrical sockets should not be mounted onto party walls – this may be relevant in the public access areas – however this is not always practical therefore the following should be the method to use.

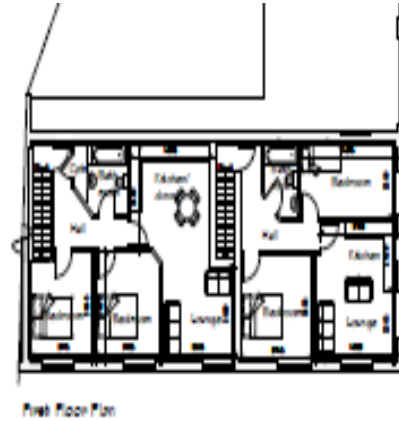
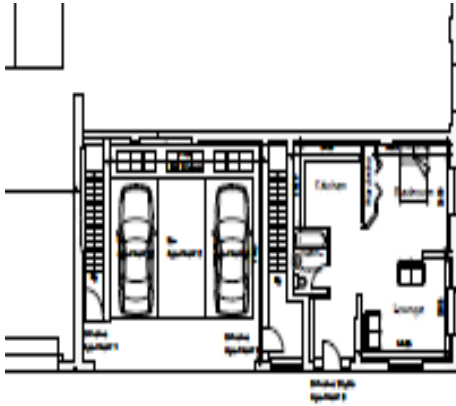
If they are mounted in party walls then on no account must they be mounted 'back to back' as this will provide a direct sound path for noise between apartments – they must be staggered by at least 600mm

If electrical sockets are to be mounted into the studded wall then the following must be followed :



Roger Leach AMIOA

Dated : November 2016



Pilkington Optiphon™

	dB sound reduction index by octave band – Hz						$R_w(C;C_w)$	R_w	R_w+C	R_w+C_w
	125	250	500	1000	2000	4000				

Configuration single glazing

6.8 mm Pilkington Optiphon™	21	26	31	35	37	38	35(-1;-3)	35	34	32
8.8 mm Pilkington Optiphon™	24	28	34	38	37	43	37(-1;-4)	37	36	33
10.8 mm Pilkington Optiphon™	28	31	36	38	39	47	38(-1;-2)	38	37	36
12.8 mm Pilkington Optiphon™	30	32	37	39	41	51	39(-0;-2)	39	39	37
16.8 mm Pilkington Optiphon™	29	34	37	39	46	55	40(-0;-2)	40	40	38

Configuration Insulating Glass Unit (IGU), thickness in mm

6 / 6 to 20 mm / 6.8 Pilkington Optiphon™	23	24	34	42	43	52	38(-2;-5)	38	36	33
6 / 6 to 20 mm / 8.8 Pilkington Optiphon™	24	26	40	48	46	54	41(-3;-7)	41	38	34
6 / 6 to 20 mm / 10.8 Pilkington Optiphon™	23	28	41	47	45	55	42(-3;-7)	42	39	35
6 / 6 to 20 mm / 12.8 Pilkington Optiphon™	20	29	43	47	46	49	42(-3;-8)	42	39	34
8.8 Pilkington Optiphon™ / 6 to 20 mm / 12.8 Pilkington Optiphon™	26	36	46	50	52	63	47(-2;-7)	47	45	40
16.8 Pilkington Optiphon™ / 6 to 20 mm / 16.8 Pilkington Optiphon™	29	40	45	47	54	68	48(-2;-6)	48	46	42

The above IGUs with Pilkington K Glass™ on one pane and a 16 mm 90 % Argon-filled cavity achieve a U value of 1.5 W/m² K. Further information on solar and thermal performance is available on the Pilkington website using the Spectrum program: www.pilkington.com/spectrum. Impact classification EN12600 Class 1(B)1 for all above Pilkington Optiphon™ products. $R_w(C;C_w)$ are in accordance with EN717-1.

Non Pilkington Optiphon™ glass products. Figures from BS EN 12354

	dB sound reduction index by octave band – Hz						$R_w(C;C_w)$	R_w	R_w+C	R_w+C_w
	125	250	500	1000	2000	4000				

Configuration single glazing

4 mm Float Glass	17	20	26	32	33	26	29(-2;-3)	29	27	26
6 mm Float Glass	18	23	30	35	27	32	31(-2;-3)	31	29	28
8 mm Float Glass	20	24	29	34	29	37	32(-2;-3)	32	30	29
10 mm Float Glass	23	26	32	31	32	39	33(-2;-3)	33	31	30
12 mm Float Glass	27	29	31	32	38	47	34(-0;-2)	34	34	32

Configuration Insulating Glass Unit (IGU), Float glass, thickness in mm

4 / 6 to 20 mm / 4	21	17	25	35	37	31	29(-1;-4)	29	28	25
6 / 6 to 20 mm / 6	20	18	28	38	34	38	31(-1;-4)	31	30	27
6 / 6 to 20 mm / 4	21	20	26	38	37	39	32(-2;-4)	32	30	28
10 / 6 to 20 mm / 4	24	21	32	37	42	43	35(-2;-5)	35	33	30
10 / 6 to 20 mm / 6	24	24	32	37	37	44	35(-1;-3)	35	34	32

Note that these are conservative figures and cover all products by European glass manufacturers.
 R_w = Weighted sound reduction. This scale allows for the response of the human ear and could be used for determining a suitable product to reduce noise such as voices.
 C = An adjustment to the R_w scale that could be used for selecting a product to reduce noise from music, radio, tv, high speed traffic and other medium to high frequencies.
 C_w = An adjustment to the R_w scale that could be used for selecting a product to reduce noise from urban road traffic, disco music and other noises with a large component of low frequencies.
 Note that a 3 dB difference is barely discernable, 5 dB is clearly discernable and 10 dB is a doubling or halving of the noise.